INDIAN SCIENCE CONGRESS CALCUTTA 1962
PART III

A/L

PROCEEDINGS
OF THE
THIRTY-NINTH
INDIAN SCIENCE CONGRESS

CALCUTTA, 1952.

P 134 261 274

NO 217 32 67

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE
16 DEC. 1957
LIBRARY
MYSORE

PART—III

ABSTRACTS

Published by the Indian Science Congress Association,
1, Park Street, Calcutta, 16.

1951.

PROCEEDINGS OF THE THIRTY-NINTH INDIAN SCIENCE CONGRESS

PART III—ABSTRACTS

CONTENTS

		Page.
1.	Mathematics	1
2.	Statistics	14
3.	Botany	18
4.	Anthropology and Archaeology	43
5.	Chemistry	48
6.	Geology and Geography	167
7.	Medical and Veterinary Sciences	191
8.	Physics	209
9.	Engineering and Metallurgy	233
10.	Physiology	253
11.	Psychology and Educational Sciences	277
12.	Agricultural Sciences	289
13.	Zoology and Entomology	310

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF MATHEMATICS

President : Dr. B. B. SEN, D.Sc.,

Abstracts

1. An Algebraic Identity on Higher Differences.

S. C. CHAKRABORTI, Jadavpur.

If $\left[{n \atop c}\right] = (a^n - 1)(a^{n-1} - 1)(a^{n-2} - 1) \cdots (a^c - 1)$ and if ${}^n s_p$ denote the sum of the products of n factors $1, a, a^2, \ldots a^{n-1}$ taken p at a time, then

$$\sum_{p=0}^{n} (-)^p \frac{\left[{p \atop 1}\right]}{\left[{x+p \atop x}\right] a^{p(n-1)}} {}^n s_p = \frac{a^n}{a^{x+n} - 1}$$

2. A Note on Entire Functions.

S. K. SINGH, Aligarh.

In this paper I consider a number of different problems connected with entire functions of finite or infinite order and prove the following:—

Theorem 1. For $r_1 < r_2$ and $f(z) = \Sigma a_n z^n$, $a_n \geq 0$

$$\frac{M(r_1)}{M(r_2)} > k \frac{M'(r_1)}{M'(r_2)} > k^2 \frac{M''(r_1)}{M''(r_2)} > \cdots > \frac{k^n M^n(r_1)}{M^n(r_2)}$$

where $0 < k < 1$

Theorem 2. If $0 <_1 \leqslant r \; r_2 \leqslant r_3 \leqslant r_4$ then

$$\frac{\mu(r_1)}{\mu(r_2)} \geqslant \frac{\mu(r_3)}{\mu(r_4)}$$

(For analogous results and definitions etc. see S. M. Shah, J.I.M.S. Vol. IX, No. 2, 1944, pp. 54-55 and Quart J. Math. Oxford 2, 1 (1950), 112-16).

Theorem 3.

If $f(z)$ is of finite order ρ and lower order λ

then

$$\lim_{r\to\infty}\begin{matrix}\text{Sup.}\\ \text{Inf.}\end{matrix}\ \frac{\log\left\{r\mu'(r)\Big/\mu(r)\right\}}{\log r}\ \begin{matrix}=\rho\\ =\lambda\end{matrix}$$

Theorem 4.

Let $|f(0)| = 1$ and

$R \geqq r > 0$ then

$$\frac{M(R)}{m(r)} \geqslant \left(\frac{R}{r}\right)^{n(r)}$$

and

$$\frac{m(R)}{M(r)} \leqslant \left(\frac{R}{r}\right)^{n(R)}$$

where $m(r)$ is the minimum $\underset{|z|=r}{}|f(z)|$ and n(r) has usual meaning.

3. On the Cesaro Summability of Fourier's Series.

D. P. BANERJI, Poona.

Let $f(x)$ be integrable in the Lebesgue sense and periodic with period 2π and $f(x) = \frac{a_0}{2} + \sum_{1}^{\infty}[a_n \cos nx + b_n \sin nx]\ldots(1)$

and $\phi(t) = f(x+2t) + f(x-2t) - 2s$, where $s = \underset{t=0}{Lt}\int_{2t}^{\infty}\frac{\phi(u)\,du}{u}$

Then Hardy and Littlewood (1932) proved that if (i) $\phi(t) = o\left(\frac{1}{\log\frac{1}{t}}\right)$ (ii) and $a_n = o\left(n^{-\delta}\right)\left(\delta > o\right)$, then the Fourier's series (i) converges to s at $t = x/2$. They have shown that their condition breaks if condition (ii) is omitted. Here I shall prove that the Fourier's series is summable $(C,1)$ if

$\lambda(t) = o\left(\frac{I}{\log\frac{1}{t}}\right)^{\alpha}$ without any condition similar to (ii)

where $\lambda(t) = \int_{o}^{t} \frac{\phi(t)\,dt}{\sin^2 t}$, and $o < \alpha \leqslant 1$

Now $\phi(t) = f(x+2t) + f(x-2t) - 2f(x)$

$= -\sin^2 t \quad F(t, x)$ and $\phi(o) = o$

Let us define the function $\phi(t)$ like Lebesgue's first example (1905). Let $o, x_0, x_1, \ldots\ldots$ be positive integers increasing indefinitely and $x_1, = 2$.

In the interval $\left(\frac{\pi}{x_{r-1}}, \frac{\pi}{x_r}\right)$, $\phi(t) = C_r \cos x_r\ t \sin^2 t$,

where $C_1, C_2 \ldots\ldots$ are numbers tending to zero such that $\underset{r \to \infty}{Lt} \frac{C_r}{\log x_r} \to o.$

Then $f(x)$ is completely determinate for sufficiently small x and elsewhere it is defined by the conditions that it is continuous and of period 2π. It is evident $\phi(t)$ is integrable in $\left(o, \frac{\pi}{2}\right)$ and $\lambda(t) = o\left(\frac{I}{\log {}^1/_t}\right)^{\alpha}$.

Let s_n denote the *nth* Fejer means of the Fourier's series at a point x,

then $f(x) - s_n = \frac{1}{\pi}\int_{0}^{\frac{\pi}{2}} \lambda(t) \sin 2x\, t\, dt + o(1)$

$$= \frac{1}{\pi}\left[\int_{0}^{\frac{\pi}{x_r}} + \int_{\frac{\pi}{x_r}}^{\frac{\pi}{x_{r-1}}} + \int_{\frac{\pi}{x_{r-1}}}^{\frac{\pi}{2}}\right] \lambda(t) \sin 2\,xt\, dt + o(1) \to o$$

as $r \to \infty$.

Hence the Fourier's series is (C,1) summable.

4. On Certain new properties of Fourier Constant.

Here I shall consider some new and interesting properties of Fourier's Constant.

(1) If $f^r(x)$ is continuous *L*-integrable and periodic function

for $r = o, 1, 2,$ then $\mathrm{Lt}_{n \to \infty} n^3 a_n = \mathrm{Lt}_{n \to \infty} n^3 b_n = o$

(2) If $\{ f(x) \}^2$ and $\{ g(x) \}^2$ are integrable

then $$\tfrac{1}{2} a_o \alpha_o + \sum_{1}^{\infty} \left(a_n \alpha_n - b_n \beta_n \right) = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x)\, g(-x)\, dx$$

(3) $$\sum_{1}^{\infty} (a_n + b_n)\, r^n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t)\, dt \, \frac{[1 - r \cos t + r \sin t]}{1 - 2 r \cos t + r^2}$$

where $o < r < 1.$

(4) $$\sum_{1}^{\infty} (a_n - b_n)\, r^n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t) \left[\log \sqrt{1 + r^2 - 2r \cos t} + \tan^{-1} \frac{r \sin t}{1 - r \cos t} \right] dt.$$

where $o < r \leqslant 1$

(5) $$\frac{a_o}{\sqrt{a^2 - b^2}} + \frac{2}{\sqrt{a^2 - b^2}} \sum_{1}^{\infty} \left(a_n^2 + b_n^2 \right) \left\{ \frac{\sqrt{a^2 - b^2} - a}{b} \right\}^n$$

$$= \frac{1}{\pi^2} \int_{-\pi}^{\pi} \int_{-\pi}^{\pi} \frac{f(x+t)\, f(t)\, dt dx}{a + b \cos x}$$

(6) $$\frac{1}{\pi^2} \int_{-\pi}^{\pi} \int_{-\pi}^{\pi} [f(x+t) + f(x-t)]\, [f(x) + f(-x)]\, f(t)\, dx\, dt$$

$$= 2\, a_o^3 + 4 \sum_{1}^{\infty} a_n^3.$$

(7) $$4 \sum_{1}^{\infty} n\, b_n^3 = \frac{1}{\pi^2} \int_{-\pi}^{\pi} [f(x) - f(-x)]\, dx \int_{-\pi}^{\pi} [f'(x-t) - f'(x+t)]\, f(t)\, dt.$$

5. A Set of Eight Associated Points.

SAHIB RAM MANDAN, Karnal.

The vertices of the eight cones belonging to the net of quadrics, $k^2p_1 + kp_2 + p_3 = o$, where $p_i = o$ are any three quadrics, form an associated set.

6. Shortest Distance.

SAHIB RAM MANDAN, Karnal.

Let a′, b′, c′ be the shortest distances of the pairs of lines b, c; c, a; a, b and a″, b″, c″ be the shortest distances of the pairs of lines a, a′; b, b′; c, c′; then the triad of lines a″, b″, c″ have the same shortest distance d. (Peterson-Morley Theorem).

7. On Exceptional Values of Entire Functions (I).

S. M. SHAH, Aligarh.

Let E denote the set of positive non-decreasing functions $\phi(x)$ such that $\int_A^\infty \frac{dx}{x\phi(x)}$ is convergent. Define a number α $(o \leqslant |\alpha| < \infty)$ exceptional value (e.v.) E for an entire function f(z) if, for some $\phi \subset E$,

$$\liminf_{r \to \infty} \frac{\log M(r)}{n(r,\alpha)\phi(r)} > 0.$$

We prove —

THEOREM 1: (i) If α is a v.e. B(Borel), then it is also a v.e. E but the converse is not true.

(ii) If α is a v.e. E, then it is also a v.e. N(Nevanlinna) but the converse is not true.

(iii) If f(z) has a v.e. E, then ρ is necessarily an integer and f(z) is of perfectly regular growth order ρ ; also f(z) can have no other v.e. E or N.

THEOREM 2: If for a function, the deficiency sum (excluding $\alpha = \infty$) $\Sigma\delta(\alpha) = 1$, , then there cannot be two values e.E for simple zeros.

Corollary. If a function has a v.e. E for the whole aggregate of zeros, then there can be no other v.e. E for simple zeros.

THEOREM 3: Let f(z) be of order ρ and suppose that either is non-integer, or when ρ is integer or zero then f(z) satisfies the condition

$$\limsup_{r \to \infty} \frac{\log M(r)}{r^\rho L(r)} = 1$$

where L(r) is any Karamata function. Then there cannot be more than two values e.E for simple zeros. Further there cannot be more than one v.e. E for the joint sequence of simple and double zeros and if such a value exists, the sequence of simple zeros is normal E for every other value.

8. On some Figurate Numbers and Associated Generating Functions.

N. M. BASU, Aligarh.

It has been known for a long time that there are an infinity of triangular numbers which are also squares. Such numbers have been investigated by many mathematicians including Euler, Re'alis, Catalana Roberts and others. It has been shown in this paper that these numbers are the set $(x_n, y_n)^2$, $(n=0, 1, 2, 3, \cdots)$ the numbers x_n, y_n being given by the generating functions

$$\frac{1+t}{1-2t-t^2} \text{ and } \frac{1}{1-2t-t^2}$$

respectively. It is also shown that no triangular number is a fourth power. Certain other interesting results have also been discussed.

9. Gibbs Phenomenon for Summability (G.K.).

B. N. PRASAD and S. R. SINHA, Allahabad University.

It has been shown here how the summability G, introduced by Piranian (Bulle. Amer. Math. Soc., 52, 1946, 882-889) and later on extended by Wing (ibid., 55, 1949, 146-155) to order K where K $\geqslant$ 1, can be utilized to generalize the ordinary Nörlund method of summation and thereby two theorems have been established which deal with the non-persistence of the Gibb's phenomenon for the (G,K) method of summation.

THEOREM 1: "Let (G,K') and (G,K") be two regular methods of summation with positive co-efficients and let

(i) $K_n \geqslant 0$ for all n,

(ii) $\sum_{j=0}^{n} K_j = o\left\{p_n''(K''+1)\right\}$ as $n \rightarrow \infty$;

where $\{K_n\}$ is defined by the relation

$$\sum_{n=0}^{\infty} K_n z^n = \frac{\sum_{n=0}^{\infty} p_n''(K'')z^n}{\sum_{n=0}^{\infty} p_n'(K')z^n} = \frac{\sum_{n=0}^{\infty} p_n''(K''+1)z^n}{\sum_{n=0}^{\infty} p_n'(K'+1)z^n}$$

"If the sequence $\{s_n(x)\}$ is bounded in the neighbourhood of $x = x_1$, then the non-persistence of the Gibbs phenomenon for (G,K') method would necessarily imply the same for the (G,K") method."

THEOREM 2: "If p_n (K') > 0 and monotonic non-decreasing, the G_n (K') means of the partial sums of the Fourier Series of any function f(x) must fail to exhibit the Gibbs phenomenon".

These theorems include as a particular case certain theorems known for the (N,p) method of summation. We get them by putting K′ = 1, K″ = 1 and

$$\sum_{j=0}^{n} \left| a_j \right| = p_n \text{ and } \sum_{j=0}^{n} p_j = p_n \text{ \&c.}$$

10. On the absolute summability of the conjugate series of Fourier series.

T. PATI, Allahabad.

Let $f(t)$ be a periodic function with period 2π and integrable in the sense of Lebesgue over $(-\pi, \pi)$. Write, for $t > 0$,

$$\Psi(t) = \Psi_x(t) = \tfrac{1}{2}\{f(x+t) - f(x-t)\},$$

$$\theta(t) = \frac{2}{\pi}\int_t^\infty \frac{\Psi(u)}{u}\,du,$$

$$\bar{\Psi}_\alpha(t) = \frac{1}{\Gamma(\alpha)}\int_0^t (t-u)^{\alpha-1}\Psi(u).du \quad (\alpha > 0)\ ;\ \bar{\Psi}_0(t) = \Psi(t)$$

and

$$\Psi_\alpha(t) = \Gamma(\alpha+1)t^{-\alpha}\ \bar{\Psi}_\alpha(t) \quad (\alpha \geq 0).$$

$\Theta_\alpha(t)$ and $\theta_\alpha(t)$ have similar meanings.

Bosanquet and Hyslop established that if $\alpha \geqslant 0$, $\psi_\alpha(t)$ is of bounded variation in $(0, \pi)$ and $\theta_\lambda(t)$ is of bounded variation in $(0, \pi)$ for some positive λ, then the conjugate series of the Fourier series of $f(t)$, at $t = x$, is summable $|C, \alpha+\delta|$ for every $\delta > 0$. This theorem was shown by them to be the best possible in the case $\alpha = 0$.

With the help of the example of the series

$$(*) \qquad -\sum_{n=2}^{\infty} \frac{\sin \frac{n\pi}{2}}{\log n},$$

which is the conjugate series of the Fourier series

$$\sum_{n=2}^{\infty} \frac{\cos n t}{\log n},$$

at $t = \pi/2$, and is itself not a Fourier series, we demonstrate that the above theorem is the best of its kind even in the case $\alpha = 1$.

The series (*) derives its interest from the fact that although it is convergent, summable $|A|$ and also summable $|C, 1+\delta|$ for every positive δ, yet it fails to be summable $|C, 1|$. That summability $|C, 1|$ is an essentially distinct type of property on account of its non-local nature is no less true in the case of conjugate series of a Fourier series than in the case of a Fourier series itself.

11. Matrix Integration.

BHAGWAT SWARUP SAXENA, Aligarh.

This paper is in continuation of a paper by P. S. Dwyer and M. S. Macphail { Annals of Maths. Statistics XIX (1948) pp. 517-534 } . Let X denote the matrix (x_{mn}), 't' a scalar. We define $\int X\, dt$, $\int t\, dX$, and devise a method to calculate integrals of specific matrix products. We consider also the integrals of sums, power, the inverse matrix and the function of a function.

12. On comparison of the total strength of some Hausdorff Matrices.

S. K. BASU, Calcutta.

The problem of total relative strength of the Holder Matrix H^{α} and Cesaro matrix C^{α} of order $\alpha > -1$ has been solved by the author in a previous paper [Proc. London Math. Soc. (2), 50 (1948), 447-62]. These are two special types of Hausdorff Matrices. In the present note the question of total relative strength of some more Hausdorff Matrices such as Γ_{β}, Γ_{β}^{α}, J^{β} [Hausdorff, Math. Zeit. 16 (1923), 220-248] has been considered.

13. On Clifford's Parallelism in a Riemannian Space.

R. N. SEN and M. C. CHAKI, Calcutta.

Prof. E. T. Whittaker established the differential equations of Clifford's right or left parallelism in a 3-dimensional elliptic space (Jour. Lond. Math. Soc. Vol. 5, (68), 1930). The present paper gives a certain connection between a pair of teleparallelism in an n-dimensional Riemannian space which may be made to satisfy Whittaker's equations of Clifford's parallelism.

14. A Unit Identity on Higher Differences.

S. C. CHAKRABARTI, Jadabpur.

$$\sum_{p=0}^{n} (-)^{p} \frac{a^{n-p}-1}{a^{p+1}-1}\, a^{p}\, {}^{n}s_{p} = 1$$

where ${}^{n}s_{p}$ denotes the sum of the products of n factors $1, a, a^{2}, \cdots a^{n-1}$ taken p at a time.

15. On the computation of the inverse of a matrix.

OMAR ALI SIDDIQI, Aligarh.

The computation of the inverse of a non-singular square matrix is an important process in the matrix theory and its applications. The standard formula $a^{-1} = \frac{1}{|a|}\left[a_j\right]$ for a matrix a of order n requires the laborious task of the computation of $|a|$ and n^2 of its first minors. The methods of Burgess and others discussed in the Elementary Matrices, by Frazer, Duncan and Collar are restricted and based on lengthy theory and scheme of work. The object of this paper is to develop a simple and exact method requiring least theoretical and practical working. The matrix eq. $a\ x = k$ is reduced to $x = b\ k = a^{-1}\ k$ with the application of elementary row operations alone. Some examples and the case where $a\ x = b$ reduces to $HX = b\ k$, H a Hadamard Matrix, are considered.

APPLIED MATHEMATICS

16. Relationship between viscous and non-viscous solutions.

B. R. SETH, Kharagpur.

When a rigid body moves slowly through a viscous liquid at rest at infinity the effect of viscosity of the surrounding liquid is to induce a wrench acting on the body. In the case of non-viscous liquids this wrench is absent. The presence of the body can therefore be replaced by a wrench-nucleus. Thus viscous solution may be obtained by superposing on the corresponding irrotational solution a solution due to a wrench-nucleus acting in an infinite viscous liquid. The latter problem is the same as that of finding displacement components in an incompressible solid due to a given set of nuclei of strain. This method has already been used for the translation of a sphere and a circular cylinder (B. R. Seth, Proc., Ind. Acad. Sci., 16 (1942), 193-195). It is proposed to extend it to the case when they rotate in an infinite viscous liquid.

17. On the Equilibrium of a thin atmosphere round a heavy central core: Spheroidal and anchor-ring configurations.

N. L. GHOSH, Calcutta.

In this paper we have shown that a mass of thin heterogeneous fluid surrounding a heavy central core can remain in equilibrium in the form of a spheroid or in the form of an anchor-ring of elliptic meridional section. In the solution obtained the density can diminish steadily outwards under certain conditions. It has been shown that if the height of the spheroidal atmosphere above the central spherical core never exceeds 25 per cent. of the radius of the core, the density of the thin surrounding fluid will diminish continuously outwards.

In the case of the anchor-ring form it is found that the ring can reduce itself to a flat plate without violating the conditions of equilibrium.

18. Derivation of Lagrangian and Hamiltonian Equations of Motion from the Dynamics in Hyperspace.

N. N. GHOSH, Calcutta.

This paper deals with the development by means of determinants of a new method of deriving Lagrangian and Hamiltonian equations of motion corresponding to the holonomic dynamical system containing n/3 particles with r degrees of freedom. As is well known, such system may be regarded as equivalent to a single 'generalized' particle moving on an r-dimensional variety immersed in a euclidean n-space. The velocity and the acceleration vectors at any point are then respectively in the tangent subspace and the osculating subspace of the second order of the variety at that point. Defining, next, the momentum vector in the most general way and equating its derivative to the 'generalized' force vector in accordance with the Newtonian mechanics one can obtain the vector equation of motion of the particles. The Lagrangian and Hamiltonian equations in the characteristic scalar forms then follow by making a transition in two different ways to a subspace of lower dimension, thus eliminating the unknown components of the generalized force vector. The complementary part to this transition, however, includes equations involving the unknown reactions which can be determined when the Lagrangian equations have been solved. The determination of the generalized force vector is a note-worthy feature in this treatment, but it has yet to be investigated what part this would play in regard to a system of particles moving in ordinary space.

19. Note on the possibility of Polytropic Stars with Power Law for Opacity and sub-atomic Energy Generation.

G. BANDYOPADHYAY, Darjeeling.

A star of finite mass in which the opacity and the rate of sub-atomic energy generation are proportional to products of powers of density and temperature and further in which the gas pressure predominates over radiation pressure, can be a polytrope (i.e. density is some finite power of temperature) only if the rate of production of sub-atomic energy is uniform either by virtue of physical law or by virtue of the actual density-temperature distribution within the star. (An isothermal model, however, has not been considered in this connection).

20. On Two-Dimensional Superposable Flows.

RAM BALLABH, Lucknow University.

The paper deals with the superposition of two-dimensional flows such that the velocity vector for the resulting fluid motion is the sum of the velocity vectors for separate motions under the same external forces. Two fluid motions (Ψ_1, ζ_1), (Ψ_2, ζ_2) are found to be superposable if

$$\frac{\partial(\Psi_1, \zeta_2)}{\partial(x, y)} + \frac{\partial(\Psi_2, \zeta_1)}{\partial(x, y)} = O.$$

General results have been obtained, for the case when one flow is irrotational.

In the case of self-superposable flows it is found that the vorticity is constant along the stream lines. Flows possessing this property have been the subject of interesting studies and some new properties have been obtained for them.

21. On the Methods of Determination of the Response Characteristics of Electromagnetic Seismographs.

S. K. CHAKRABARTY, Sibpur.

Two different methods have been suggested for the estimation of the dynamic magnification and the response characteristics of electromagnetic seismographs. Instead of the usual "Shaking table" experiments, a much simpler method has been suggested by which a uniform simple harmonic motion can be impressed on the boom of the seismometer, with the help of a 'Sine Wave Simulator'. Corresponding motions of the seismometer $x(t)$ and galvanometer $\sphericalangle(t)$ are recorded on the same seismogram. By analysing these records and comparing with the theoretical results on the response characteristics deduced in the present paper it is possible to get an accurate estimate of the response characteristics for the entire range of frequencies in which these instruments are used. By the second method the magnification and the response characteristics can be obtained purely from the measurement of the maximum values of x and $\sphericalangle$ and is very convenient particularly when the seismometer and the galvanometer are not critically damped and the theoretical results required in the first method involve tedious calculations.

22. Initial Motions of the Elements of a Seismograph and their connections with the Response characteristics of the Seismograph.

B. B. CHATTERJEE, Sibpur.

The response characteristics of electromagnetic seismographs have been obtained by different authors under different initial conditions. While Galitzin has assumed a finite initial velocity for the Seismometer, Rybner and Chakravarty have taken both the Seismometer and galvanometer to be initially at rest. The transient term in the solution depends critically on the initial conditions, but the steady state solutions which are being used for qualitative work in earthquake seismology do not at all depend on the initial conditions. In the present paper we have solved the equations assuming that $\dot{X}_0$ and $\dot{\Theta}_0$ represent the initial velocity of the seismometer and galvanometer. Even from the analysis it is now possible to show that $\dot{X}_0$ and $\dot{\Theta}_0$ must be zero specially when the instruments satisfy Galitzin conditions. Numerical results have also been given for other combinations and a comparison with the results of "shaking table experiments" and also with ordinary earthquake records show that $\dot{X}_0$ and $\dot{\Theta}_0$ must be zero as assumed by Rybner and Chakravarty.

23. The effect of two equal circular holes on the stress distribution in a beam under uniform bending moment.

A. M. SEN GUPTA, Sibpur.

In this paper the influence on the stress distribution of two equal circular holes with their centres at the neutral axis of a deep beam of rectangular cross section under uniform bending moment M has been discussed. For this purpose, bipolar co-ordinates are introduced. The numerical values of the circumferential stress $\widehat{\beta\beta}$ on the boundary of the circular hole $\alpha = c$ for positive values of β between 0 and π when $c = \cdot 8$ are given in a table. Finally the results obtained have been compared with those in a beam with a single hole.

24. Flexure of an isotropic elastic cylinder whose cross-section is bounded by two closed curves.

D. N. MITRA, Calcutta.

The flexure problem of the above cylinder is solved by the function-theoretic method. The result obtained in this paper are more general than those obtained by Morris (1950, Proc. Lond. Math. Soc., **51,** Part 6, p. 424) in her formal solution of the flexure problem of the same cylinder. The solution of the particular case for the cross-section bounded by two eccentric circles has also been deduced and the results for the co-ordinates of the centre of flexure are found to agree with those of Morris.

25. Axisymmetric viscous flow past two spheres.

S. D. NIGAM, Kharagpur.

The axisymmetric viscous flow past two spheres A and B whose centres are at a distance c apart and whose line of centres is parallel to the direction of the undisturbed flow is discussed by the method of superposition. Two stream functions ψ_A and ψ_B are constructed and the boundary conditions satisfied both on the surface of the spheres and at infinity. The corresponding expression for the drag is similar to that found by Jeffery and Stimson who solved the same problem by a different method. The advantage of this method is that it can be extended to cases of non-steady and periodic flow.

26. Anharmonic Pulsations of a Stellar Model.

L. D. CHATTERJI, Allahabad.

Anharmonic pulsations of a slellar model in which the density is proportional to $1 - r^2/R^2$ are considered. The skewness of the radial velocity curve obtained is in conformity with observation, the increase in the period is found to be slight.

27. On the Energy of an Isolated Fluid Sphere.

R. V. WAGH, Poona.

The usual expression for the energy of an isolated system is given by the relation, viz.,

$$U = \iiint \left(T_4^4 + t_4^4 \right) dx\, dy\, dz \cdots\cdots (i)$$

where $\underset{\sim}{\mathfrak{T}}{}_4^4 = T_4^4 \sqrt{-g}$, the tensor density corresponding to the time-component of the energy-momentum tensor T_μ^ν, and t_4^4 is the pseudo-tensor density of the 'time' component of the gravitational energy and momentum. The integrand of the equation given above can be expressed in the form of a 'divergence' as

$$\underset{\sim}{\mathfrak{T}}{}_4^4 + t_4^4 = \frac{1}{8\pi} \frac{\partial}{\partial x^\alpha}\left(- \mathfrak{g}^{\mu 4} \frac{\partial L}{\partial \mathfrak{g}^{4\mu}_{\alpha}} + \frac{1}{2} \mathfrak{g}^{\mu\nu} \frac{\partial L}{\partial \mathfrak{g}^{\mu\nu}_{\alpha}} \right) \cdots \quad (ii)$$

With this expression and for the case afforded by the linear element

$$ds^2 = -e^\mu (dr^2 + r^2\, d\theta^2 + r^2 \sin^2\theta\, d\phi^2) + e^\nu\, dt^2 \cdots\cdots \quad (iii)$$

where $\mu = \mu(r, t)$ & $\nu = \nu(r, t)$ the expression for energy U reduces to

$$U = r^2 \left(\frac{1}{r} + \frac{1}{2} \mu' \right) e^{\frac{\mu+\nu}{2}} \Big|_0^r - \frac{1}{2} \int_0^r e^{\frac{\mu+\nu}{2}}\, dr \cdots\cdots \quad (iv)$$

In this paper, the variation of energy corresponding to the associated variation in pressure and density of matter for isolated sphere are studied. It may be pointed out incidentally, that (iv) does not agree with the expression for energy U obtained by Narlekar and co-workers, viz.,

$$U = -\frac{1}{2} \mu' e^{\frac{\mu+\nu}{2}} \Big|_0^r \cdots \quad (v)$$

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF STATISTICS

President :—Dr. N. S. R. SASTRY, D.Sc.

Abstracts

1. The Problem of Missing Quotations.

J. K. PANDE.

A common statistical problem met with in connection with the averaging of prices collected from day to day or week to week and from different centres and different stores or shops is presented by the fact that some of the quotations are not available in some weeks or in some localities or from some stores or shops. The way such missing quotations are taken into account or ignored affects the average price for the month during which prices are collected from day to day or week to week. The paper points out the statistical inaccuracy involved in the ordinary methods followed for averaging the prices for the month by pooling all the quotations available or by taking the average of the weekly prices or the locality prices, and suggests a method which removes such defects.

2. A Generalized Class of Sampling Procedures.

R. D. NARAIN, Karnatak University, Dharwar.

Consider all possible samples of size n that can be drawn without replacement from a population of N units. To each of these possible samples we may assign arbitrary probabilities subject only to the restriction that the sample provides an unbiassed estimate of the population parameter. This leaves undetermined constants $\binom{N}{n} - N$, whose values can be chosen arbitrarily. and this can be done so as to obtain most efficient results by making use of any prior information that may be available regarding the distribution of the sampled character. It can readily be seen that procedures known as cluster sampling, systematic sampling, stratified sampling, etc. are all particular cases of the above general class. In certain circumstances, it is possible to choose values of the undetermined constants which will give the maximum attainable efficiency under this class.

3. Sextiles and Octiles with the Ordinates at these Quantiles in Pearson's Type III Curve.

N. M. BHATT, M. S. University of Baroda.

Salvosa has prepared Tables giving the values of Areas and Ordinates of Pearson's Type III Curve for values of the variate in standard measure with mean as origin for various levels of skewness from $\sqrt{\beta_1}$ equal to 0.1 to 1.1. In this paper are given the sextiles and the octiles of this curve for these levels of skewness and also the Ordinates at these quantiles. The sextiles and octiles are calculated from Salvosa's Tables of Areas by Prof. Aitken's Method of Inverse Interpolation by Quadratic Extrapolation and the ordinates are then calculated from the Tables of Ordinates by Prof. Aitken's Method of Interpolation by Iteration of Proportional Parts. The values are calculated to six places of decimal.

4. On the Periodicity of floods in the Ganga River at Raiwala near Hardwar.

A. P. BHATTACHARYA, Roorkee.

A study of the total runoff (discharges) of the Ganga River at Raiwala for the monsoon months of June to September for the last 50 years has been carried out to detect the existence of cycles, if any. It has been found that the oscillations of the series of the flood discharges of the Ganga at Raiwala have a mean "period" of 3 to 4 years (twice in seven years to be exact).

5. Effects of Pumping of Tube Wells in Doabs east of the Ganga River in Western U. P.

A. P. BHATTACHARYA, Roorkee.

Effects of tube well pumping in the seven Doabs (Doab being an area lying within two rivers) east of the Ganga River in Western U. P. on the sub-soil water table have been studied with a view to finding whether the present rate of pumping tends to create any permanent depletion (which means a disaster for the countryside as it results in great scarcity of water both for drinking and irrigation in village wells). The conclusion is that in six out of seven Doabs, there is no such danger, the pumping being carried out within safe limits. In some Doabs, there is enough scope for harnessing sub-soil water supplies further for the purpose of tube well irrigation. While in one Doab, the present rate of pumping is not quite safe, and either the rate of pumping should be reduced or some wells should be abandoned.

6. On a New Approach to the Analysis of Lattice Designs.

V. N. MURTY, Bombay University.

Lattice Designs were first introduced by F. Yates in Agricultural Field experimentation for testing large number of varieties or treatments. Goulden, Cochran, and Yates have given methods of analysing such designs with and without recovery of inter-Block information. In the above paper, an altogether new approach to the analysis of Lattice Designs has been developed and the intra-Block varietal effects are obtained very easily from the inter-Block estimates. The method developed has been found to be simpler in practice than the previous methods.

7. Extension of the Romonovsky—Bartlett—Scheffe'—Berankin Test.

K. S. RAO, University of Bombay.

In a paper entitled "Extension of the Romonovsky—Bartlett—Scheffe' Test", Berankin (1949) solves the following problem: Let 'x' be a random variable, normally distributed with mean $h_1+k_1\xi$ and variance σ_1^2. Here h_1 and k_1 are constants and the mean thus linearly depends on the single sure variable ξ. The variance σ_1^2 is independent of ξ. Similarly, let 'y' be a normal random variable, with mean $h_2+k_2\eta$ and variance σ_2^2. Here likewise h_2 and k_2 are constants, η is a sure variable and σ_2^2 is independent of η. Under the set of alternatives

$$-\infty < h_1,\ h_2,\ k_1,\ k_2 < \infty$$
$$0 < \sigma_1^2,\ \sigma_2^2$$

the problem is to find an exact, unbiassed test for the hypothesis

$$H_0:\ k_1=k_2$$

In this paper the result of Berankin is generalised as follows:

Let x_1, x_2 be p -dimensional vectors having p -variate normal distributions with mean vectors $C_1'\xi_1,\ C_2'\xi_2$ and dispersion matrices Λ_1, Λ_2 where the $\xi's$ are 1 × p 'sure' variable matrices and $C's$ are 1 × l constant matrices.

In this paper, an exact, unbiassed test for the hypothesis

$$H_0:\ C_1=C_2$$

against a suitable set of alternatives as in Berankin's case, is obtained as a Hotelling's T^2.

REFERENCE

Berankin, E. W.: Extension of the Romonovsky—Bartlett—Scheffe' Test, Berkeley Symposium on Mathematical Statistics and Probability. Ed. by Neyman (1949).

8. Tests for Independent Normality in Economic Time Series.

K. S. RAO, University of Bombay.

The nulhypothesis H_0 that $u_1, u_2 \cdots u_n$ constitute independent observations of a normal variate is of fundamental importance in Economic Time Series, where there is little scope for observation of variables under experimental conditions. H. O. Hartley (1949) tests the above hypothesis against the alternative hypothesis that the first 'm' intensities of the periodogram of the series are greater than zero. Also, in fitting a regression equation by the method of least squares and applying the usual tests of significance for the regression co-efficients we require that the residuals in the regression set-up are independently normally distributed. Durbin and Watson (1950) test this hypothesis by using the data itself, against the alternative that the residuals form a simple Markhoff chain.

In this paper the general problem connected with the correlated residuals of a number of simultaneous regression equations is tackled. The nulhypothesis is tested against a wider class of alternatives, which usually arise in the Analysis of Economic Time Series.

REFERENCES

(i) H. O. Hartley (1949) Biometrica Vol. 36.
(ii) J. Durbin and G. S. Watson (1950) Biometrica Vol. 37.

9. Equilibrium Exchange Rate of the Rupee.

V. NARASIMHAMURTI and V. KASISASTRI, Bombay.

Defining the equilibrium exchange rate as the rate capable of maintaining the equlibrium of the balance of payments during a certain period of time, we have made an attempt to evaluate the equilibrium exchange rate of the rupee during the year 1950-51 taking the first post-partition year 1948-49 as the basis of our computations. For this we have estimated the normal volume of exports and imports (food and other than food imports having been treated separately) during the year 1950-51. We have then formulated the equilibrium condition for balance of payments during the year 1950-51 from which we have estimated the values of equilibrium exchange rate under various assumptions regarding the elasticities of demand for exports and imports based on the results obtained by the authors in their paper 'Elasticities of Demand for certain Indian Exports and Imports'.

10. Analysis of G. R. Forms.

M. D. BHAT, Bombay.

This paper deals with the attempts made on a sample of G. R. forms to estimate the differences between the value of exports from India as shown by the Customs and that as shown by the Exchange Control Department. The study is intended to cover major ports in India and for some of the recent years. Attempts have also been made to estimate the freight, insurance and other relevant details in respect of these exports.

11. Distribution of Income in India.

V. NARASIMHAMURTI and V. KASISASTRI, Bombay.

In this paper a study of the distribution of taxable incomes in the three major states Bombay, Madras and U. P. during the post-war period 1945-46 to 1948-49 as compared to a pre-war year 1938-39 has been made with a view to examining (i) the trend in the concentration of personal incomes before and after tax using Lagrange curves, (ii) the position of income-tax revenue in relation to the total-tax revenue in each state, (iii) the trend of effective rate of taxation, and (iv) the changes in the burden of taxation from one income-group to another during the period.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF BOTANY

President :—Dr. S. RAMANUJAM, M.A., Ph.D., (Lond.), F.N,I.

Abstracts

1. Lateral Archegonia of *Pinus Roxburghii* Sargent.

V. N. TANKHA, Delhi.

An investigation of the life history of *Pinus roxburghii* showed the presence of abnormally placed archegonia in about a dozen prothalli fixed from April 13, 1950, to May 13, 1950. Variations of two types have been noticed, namely the presence of lateral archegonia alone, or lateral archegonia with a normal group of apical archegonia. The number of lateral archegonia in a prothallus varies from one to seven and these may be situated anywhere from the upper to the basal region.

The nucleus of one terminal archegonium was found to be as large as 360 microns in diameter (average size being approximately 144 microns), and in another case the nucleus of a lateral archegonium was found to be greatly elongated and extended from near the neck to almost near the centre of the cell. The lateral archegonia never develop further after the ventral canal cell has been cut off even though the terminal archegonia may get fertilized and show the proembryonal stages.

Nothing definite can be said about the true significance of the occurence of lateral archegonia in *Pinus*.

2. On a common species of *Curcuma* of Bombay & Salsette Islands.

H. SANTAPAU S. J., Bombay.

The genus *Curcuma* is in need of a thorough revision, which is impossible from the materials preserved in our Indian herbaria. The root system is essential for identification but unfortunately the roots are missing in most of the collections, even from those in the best herbaria. The central or lateral position of the spike is not a good diagnostic character, since it varies with the season of the year with one and the same plant. From examination of many specimens in the field and herbarium it is clear that our common Bombay plant is *C. inodora* Blatt.

3. Vegetation of Jodhpur and its neighbourhood 'A Preliminary Survey'.

SHANTI SARUP, Jodhpur.

A list of plants occuring in the neighbourhood of Jodhpur is given. Jodhpur is a dry place. Annual rainfall is about 13 inches. The temperature during summer is high. So the vegetation is scanty and xerophytic. *Capparis-Prosopis* are dominant. *Euphorbia* is common on hillocks. *Calotropis* and *Zizyphus* form local associations at some places.

Plant succession leads to Xerophytic and leafless species found generally in the desert plains.

4. Study of Plant Succession in Kanheri National Park, Bombay.

R. B. Dass, Jodhpur.

The Kanheri National Park, Bombay, falls under the moist deciduous climatic climax vegetation in which *Tectona grandis* and *Terminalia tomentosa* form fifty percent of the trees.

In one area about 300 ft. high, *Adina cordifolia* replaced almost completely the original vegetation after this moist deciduous forest was cut. On further cutting. *Adina cordifolia* is replaced by the *Bambusa arrundinaceae* more specially on the lower slopes of the hills near the rivers. After further cutting and disturbance a mixed shrub layer appears of *Holarrhena antidysentrica, Wrightia tinctoria* and *Calycopteris floribunda*.

On cutting the plants still further and pasturing, a mixed stand of *Holarrhena antidysentrica, Themeda triandra, Setaria, glauca, Celosia argentea* and *Pseudanthistiria heteroclita* form the fourth stage of plant succession. This is followed by *Eulalia fimbriata* Finally in the area greatly trampled by man and intensively grazed by cattle. *Eulalia fimbriata* in its turn has been found giving way to *Eragrostis unioloides* which forms the sixth stage of plant succession.

The ultimate result of indiscriminate pasturing, trampling and soil erosin is a ground totally rocky and stony with weeds like *Blumea eriantha, Elusine indica, Cleoma viscosa Boerhaavia diffusa* and many *Cyperacea.* However *Blumea eriantha* having two fold advantage of propagating itself vegetatively by stolons as well as by its light cypsella fruits, wins the ground and the seventh or the final stage of degredation is reached wherein *Blumea eriantha* is dominating.

If however the vegetation is burnt either at stage 2, 4 or 5 the ground in the next season is covered by *Pogostemon parviflorus.*

Thus it has been observed that as a result of intensive biotic activities moist deciduous forest has been reduced to more grassland in Kanheri National Park, Bombay.

5. Pharmacognosy of Indian Ephedras.

B. GUPTA and S. N. BAL, Calcutta.

Ephedra is a cardiac medic inal plant of great fame. Four Ephedras occur in India. *E. nebrodensis* and *E. gerardianna* are active and official and *E. intermedia* and *E. foliata* are nonactive. Indian Ephedras have great future if they are standardised.

Good quality Ephedras can cultivated in arid zones of Northern India. Seeds or root-stocks should be planted thickly in early spring and should be watered and weeded for a year. They should be harvested in blossom time from four-year old male plants and dried in sun. They should be stored in cool, dry and dark places.

The minute, scaly and opposits leaves are connate variously, and length and breadth of internodes are different in some cases. The amount of lignification of hypodermal, mesocortical, pericyclic and permedulary fibres is different depending on the differences of species, maturity and position. Stomatal number, size of guard cells, presence and absence of papilae of stem epidermis are characteristic. Differential and diagnostic characters have been detailed in tabular forms.

6. Morpho-ecological studies into the thorns (= Spines of South Indian Plants—1.

M. JAYA MARIE, (Miss.), Trichinopoly.

The study comprises of an investigation on 45 species of Angiospermic plants from the South Indian Flora spread over 20 families of diverse phylogenetic relationships.

From the view point of morphology, the thorns (= spines) of the species investigated may be classed under the following groups :—

1. **Modification of the stem**, e.g. *Bougainvillaea spectabliis, Lawsonia alba, Dichrostachys cinera, Citrus acida,* Foronia *elephantum, Punica granatum, Hygrophila spinosa, Parkinsonia aculeata, Carissa carandus. Flacourtia sq., Amarantus spinosus, Colletia cruciata, Commiphora berryi, Barleria prionitis, Canthium sp.*

2. **Modifications of the leaf:—**
   (a) Leaf spines: *Optuntia dillenil, Berberis linctoria, Euphorbia antiquorum, Azima tetracantha, Ulex europeus, Cereus grandiflor,;*
   (b) Spinose margins: *Acanthus ilicifollus, Alce, Ag,ve americana, Aagem.ne mexicana, Solanum xanthocarpum, Mahonia leschenaultii Cnicus Wallichii.*
   (c) Leaf tip: *Ruscus ,culeatus,, Yucca sp.* and *Sansevieria.*
   (d) Stipular spines: *Asparagus racemosus, Pithecolobium dulce, Acacia arabica, Capparis zeylanic,, Zizyphus jujuba,Mimosa pudica, Euphoriba splendens, Acaci, sphaerocephala.*

In the last case myrmecophily has been observed.

3. **Modifications of the floral organs:** Spinescent Bracts, bracteoles and perianth : *Alternanthera echinata, Lepidagathis pungens, Leonotis nepetaef.lia :*

4. **Prickles:**
   (a) On the stem : *Lantana indica :*
   (b) On the rachis and midrib of leaf : *Toddalca aculeata :*
   (c) On both stem and leaf : *Rosa* sq. (wild).

7. Distribution of *Rhizophora mucronata*, Lam., in the 'Back-waters' of the Coast and its Economic importance.

C. RAJASEKHARA MUDALIAR, M.A., and Miss. H. Sunanda Kamath, B.Sc.

The paper deals with the investigation on the occurrence, distribution and the tannin content in the barks of *Rhizoph.ra mucronata*, Lam. Seasonal variation in the total solids of the 'Back-water' did not affect the tannin content. This plant was observed to thrive only when the total solids in the 'Back-water' were above 1.100. parts. The pH values throughout the course of the ten miles of the 'Back-water,' were not affected, though the total solids varied from 2,003 to 2,006 About 12 to 15 % of tannin found in the bark of this plant is considered to be a workable quantity for use in the tanning industry.

It is sugested that *Rhizophora mucronata* Lam., can be planted along both sides of the 'Back-waters' in the West Coast and also in the estuaries of rivers in the East Coast so as to prevent erosion of the banks of the 'Back water.' It is roughly estimated that about 150 to 200 miles of this forest can be developed in the West Coast alone giving a good return. The cost of cultivation is very negligible, though a systematic cultivation may require supervision charges, etc. In addition to the bark, this plant gives good fuel.

8. The bladder-wort, *Utricularia flexuosa* Vahl as a competitor for fish food.

P. I. CHACKO, Madras.

Examination of bladders of *Utricularia flexuosa* occurring in the Yercaud lake, Pookote lake, Tariode lake and San Jose estate pond, revealed the presence of 15 kinds of green algae, 1 of yellow-green alga, 12 of diatoms, 3 of protozoa, 1 of rotifer and 4 of microcrustaceans. Insect and fish larvae were absent, and therefore the India form appears to be nonpiscivorous unlike *U. vulgaris* of the temperate waters. Nevertheless, as it consumes planktonic organisms which enter into the diet of many young fishes and adult carps, it is a serious comeptitor for fish food organisms. It is therefore desirable to control its growth in waters utilised for fish culture.

9. Vegetation of the Delhi Ridge.

SUNIL KUMAR MUKHERJEE, Delhi.

The present paper deals with the vegetation of the Delhi Ridge., which consists of a narrow range of sandstone hills passing west of New Delhi and again through the Notified area terminating on the right bank of Jumna. It is a prolongation of the Aravalli Ranges and enters Delhi from the south. The temperature shows great fluctuations during the summer (max. temp. 114—118°F.) and winter (min. temp. 34-40°F.). The soil is poor and sandy and the average annual rainfall is about 25 inches, with same years showing unusually drought conditions.

The ridge maintains a representative natural vegetation of the Delhi area and contains the floral elements of the three adjoining areas, the Rajputana, the Punjab Plains and the dry western region of the upper Gangetic Plain. The characteristic species of the Ridge, some of which are also common to the above three areas, are *Prosopis spicigera*, *Acacia Senegal*, *A. arabica*, and *A. leucomphloea*, *Zizyphus rotundifolia*, *Capparis aphyll*, and *C. sepiaria*, *Cocculus villosus*, *Maerua arenaria*, *Daemea extensa*, *Salvadorn* and *S. oboides* *Ehretia laevis*, *Pluchea lanceolata* and scattered individuals of *Tecomella undulata*.

The vegetation may be grouped into two categories:—(1) the **permanent vegetation**, which is xerophytic, and (2) the **ephemeral vegetation**, consisting mainly of annuals coming up after the rains.

The list of plants includes 142 species under 41 families, of which the more common are Leguminosae (25 sp.), Gramineae (17 sp.), Compositae (10 sp.), Amarantaceae (10 sp.), Acanthaceae (7 sp.) and Capparideae (6 sp.). The following species are not recorded in Duthie's Flora:—

Vicoa indica (Compositae),, *Lepidagathis cristata* (Acanthaceae), *Alternanthera echinate* and *Gomphrena celosioides* (Amarantaceae), and 18 species of Gramineae.

10. Some aspects of the embryology of *Lawia zeylanica* and *Zeylanidiam olivaceum*.

S. P. AGHARKAR and B. A. RAZI, Poona.

Lawia zeylanica collected at Koppa and Gersoppa, Mysore, and *Zeylanidium olivaceum* (= *Hydrobriuc olivaceum*) collected at Lonavala near Poona form the material for the present study. The development of the embryo-sac in *Zeylanidium* confirms the work of Magnus on *Hydrobrium* except for certain minor differences. Magnus has shown that the primary chalazal nucleus does not divide but degenerates immediately. In the present from it persists upto the mature embryo-sac stage.

An abnormal ovule of *Zeylanidium* showed a three-nucleate embryo-sac situated outside both the integuments and appeared to have migrated to that position. This recalls similar instances seen in *Utricularia ocerulca* by Kausik and *Vandellia* and *Torenia* by *Iyengar*.

Fertilisation is porogamous in both *Lawia* and *Zeylanidium*. The pollen-tube enters between the two synergids which may persist uplto the three-celled proembryo stage in *Lawia*. Alternatively it may enter between one of the synergids and the nucellar epidermis. Double fartilisation was not actually seen in any prepartion of *Lawia*,, but was seen in a number of preparations of *Zeylanidium*. The primary endosperm nucleus appears to degenerate immediately, since no trace of it can be seen even at the time of first division of the fertilised egg.

The fertilised egg divides transversely giving a terminal cell ***ca*** and a basal cell ***cb***. The basal cell ***cb*** divides by a transverse wall to form a three-celled proembryo consisting of ***1***, ***1'*** and ***ca***. The cell ***1*** enlarges in size, becomes vesicular, and its nucleus divides a number of times. This coenocytic cell produces characteristic finger-like processes which penetrate between the two integuments. The cell ***1'*** elongates, and may divide once or twice to give rise to ***m***, **n**, and ***n'***. These last constitute the suspensor.

The cell ***ca*** divides vertically twice forming the quadrants, and the quadrants divide transversely to form the octants. There are further anticlinal and periclinal divisions in ***ca*** to give rise to the mature embryo, which is dicotyledonous, with a suspensor of two to three cells, and the persisting coenocytic haustorial basal cell with its finger-like processes.

This embryogeny corresponds generally to the Onagrad type of Schnarf; as it differs in details of development it is proposed to include it under its Podostemon variation.

11. The Endosperm in the Leguminosae.

M. ANANTASWAMY RAU, Bangalore.

A comparative study of 29 genera comprising 50 species belonging to the Papilionaceae, Caesalpiniaceae and Mimosaceae reveals that the endosperm shows considerable variation in its structure, organisation and activity. Though the endosperm development in the investigated members is of the ***ab initio*** Nuclear type, cell formation which takes place later proceeds to varying extent. The occurrence of a free nuclear chalazal portion is noticed in several species and this assumes a haustorial role in *Rothia trifoliata* and *Glycine javanica.* The presence of a characteristic tubular process with free endosperm nuclei in the chalazal part of the developing seed has been noted in species of *Crotalaria, Cassia, Parkinsonia* and *Leucaena* which are representative of the three families under investigation.

12. A Contribution to the Embryology of *Neptunia triquetra* Benth.

V. R. DNYANSAGAR, M.Sc., Raipur.

Neptunia triquetra is a low prostrate perennial herb with slender ascending compressed stems. The inflorescence is an axillary globose head and consists of 15-20 flowers. The total number of fruits formed per inflorescence is 2-5.

The primary archesporium is usually differentiated late. The tapetum is of the secretory type. It is unilayered and its cells remain uninucleate throughout. The microspore mother-cells first become separate from one another and then form tetrahedral tetrads of microspores after undergoing usual reduction divisions. The pollen grains are simple and are of the *Pronopis glandulosa* type. At the time of shedding, they are bi-celled. The n chromosome number is 18. The ovules are anatropous and have two integuments. The micropyle is formed by the outer integument alone and is at right angles to the longitudinal axis of its nucellus. Megasporogenesis follows the normal course. The archesporium is hypodermal and usually single-celled. Occasionally two archesporial cells are differentiated. An epidermal cap is formed over the original parietal tissue. The latter becomes extensive as a result of the activity of the primary parietal cell. A linear tetrad of megaspores is formed of which the chalazal functions.

The mature embryo is of the normal 8- nucleated type. The synergids are booked and each has a filiform apparatus. They are persistent even when the primary endosperm nucleus has formed several free nuclei. The antipodals form definite cells and persist as late as the first division of the primary endosperm nucleus. Starch grains appear in the mature sac.

The primary endosperm nucleus divides several times before the first division of the fertilised egg. Wall formation in the endosperm commences from the micropylar end. The development of the embryo follows the **Trifolium** Variation-Onagrad type except that a suspensor is not formed. There is a vascular strand only in the chalazal region of the ovule prior to fertilisation. During post fertilisation stages, however, the strand reaches up-to the micropyle through the outer integument.

13. Endosperm and embryo development in *Acalypha indica* L.

B. M. JOHRI, Delhi.

The sixteen nucleate embryo sac of *Acalypha indica* shows four peripheral groups of two cells each and eight free nuclei. Occasionally there may be a cell less or a cell more in some of the groups. In all cases the egg differentiates from the micropylar group only. Fusion of the free nuclei, numbering seven to ten, is completed only after fertilisation. The endosperm is free nuclear and the embryo typically dicotyledonous. An interesting feature is the presence of vascular elements in the peripheral region of the nucellus to about one-third or even half its height from the base. At the chalzal end some of the nucellar cells differentiate to form a hypostase. During the development of the embryo the apex of the outer integument swells and forms the caruncle in the mature brown seed.

14. The Nutritional Mechanism of the Embryo sac and Embryo in the Families Campanulaceae, Lobeliaceae and Stylidiaceae.

K. SUBRAMANYAM, Bangalore.

The mechanism of the nutrition of the embryo sac and embryo in Campanulaceae, Lobeliaceae and Stylidiaceae is of a varied type. In all these families, the initial nutritive requirements of the growing embryo sac are met by the cells of the integumentary tapetum which is especially conspicuous in *Stylidium graminifolium.*

A chalazal nutritive tissue is present. Part of it is used up before fertilisation and the rest soon after the formation of the chalazal haustorium. A nutritive tissue is also present in the micropylar region of the integument. It becomes conspicuous only as the micropylar haustorium is well differentiated.

In members of Lobeliaceae and Stylidiaceae the chalazal end forms a process which grows beyond the anti-podals and projects into the chalazal nutritive tissue forming a weak haustorium. The antipodal cells with their pointed lower ends in all the three families seem to be adapted for the absorption and conduction of food to the upper part of the embryo sac. The presence of starch grains in the mature embryo sac of certain members of these families may also be regarded as a nutritive device.

In all the families the micropylar and chalazal haustoria are aggressive structures. In *Stylidium graminifolium* and *Levenhookia dubia,* both these haustoria develop long tubular processes, and these penetrate in between the cells of the integument. The endosperm tissue itself which lies between the two haustoria is made up of cells densely packed with starch grains, except in the region immediately around the developed embryo sac. Probably the latter secretes an enzyme which dissolves the starch.

15. Development of Female Gametophyte in *Triumfeta rhomboidea* Jacq.

S. S. BHATTACHARJYA and J. N. MITRA, Calcutta.

A study of the development of female gametophyte in *Triumfetta rhomboidea* Jacq, a substitute fibre plant, has revealed certain interesting features. The archesporium is deep seated and consists usually of 2-3 megaspore mother cells, called as "mehrzellige archespores." Two well developed linear tetrads lying side by side in the same ovule has also been observed. However at a later stage of development all accessory mother cells or accessory tetrads degenerate. The mature female gametophyte is of normal type. The antipodals are extremely ephemeral in nature. The endosperm is of nuclear type. From a study of meiosis the chromosome number is found to be $2n=46$.

16. Preliminary Studies into the Viability of Immature Weed Seeds.

S. C. CHAKRAVARTI and GURU DAYAL PERSHAD, Agra.

Viability of seeds of the following common **Rabi** weeds of Agra collected at different stages of maturity was determined:—

Argemone mexicana L.; *Solanum nigrum* L.; *Asphodelus tenuifolius* Cav.; *Lathyrus aphaca* L.; *Vicia hirsuta* Gray; *Melilotus alba* Lamk.; *Melilotus indica* All.; *Anagallis arvensis* L.; *Oxalis corniculate* L.; *Spergula arvensis* L.; *Chenopodium album* L.; *Chenopodium murale* L.

It is found that in most of them immature seeds are capable of germination. In *Melilotus indica* and *Anagallis arvensis*, there is practically no difference in the germination percentage of mature and immature seeds. In *Argemone mexicana, Solanum nigrum, Lathyrus aphaca* and *Vicia hirsuta* there is a progressive increase in the total germination percentage as the seeds become more and more mature. In *Asphodelus tenuifolius* immature seeds germinate better than fully mature seeds.

All these weeds, specially when they are in flowers, should not be allowed to remain in the field to dry after being cut or should not be thrown in manure pits.

17. Effect of Colchicine on germination and growth of *Solanum Melongena*, Lin.

SRI GOPINATH PANIGRAHI, M.Sc., Cuttack.

Treatment of seeds with colchicine induces polyploidy as it is essentially a meiotic-poison. It was intended to try if this technique could be profitably utilised to produce polyploid fruits of *Solanum Melongena*, a vegetable crop of economic importance.

From a stock solution of 6000 parts of colchicine per million of distilled water (ppm), dilutions of 4000 ppm, 1000 ppm, 600 ppm, 60 ppm, 6 ppm and 0.6 ppm were prepared. Seeds of *Solanum Melongena* were sterilised in dilute Bromine water. Twenty ppm of every dilution was injected into the seeds under low pressure. The seeds were soaked in the solutions for 36 hours and then washed. Their germintion capacity and morphological changes were recorded.

Ten treated seedlings per treatment were grown in Hoagland's culture solution. An aerating apparatus as designed by Franco and Costa was used for aerating the roots.

It was observed that higher concentrations influence the rate and percentage of germination of the seeds, resulting in swollen hypocotyls, retarded growth of roots and stems, while lower concentrations accelerate their growth. The swollen hypocotyls lose their swelling and elongate like the rest when grown in culture solution. But these very dilute solutions of colchicine failed to effect any abnormalities of roots and stems, and hence could not induce polyploidy.

18. Rooting Response of Tropical Leaves.

B. SAMANTARAI and G. MISRA, Cuttack 3

Induction of rooting in isolated leaves of *Congea tomentosa*,, *Lantana camara* L, *Dolichos Lablab* L, *Canavalia ensiformis* L, *Heliotropium indicum* L, *Malva viscus* and *Tropaeolum majus* have been reported for the first time in India. The hormone β-indolyl butyric acid (I. B. A.) proved to be a very good root-inducing substance when the petioles of detached leaves are dipped in aqueous solutions of 100, 50, 20, 10, 5 and 2.5 ppm. of this substance. The different characters, such as the percentage of leaves rooted, the average days from treatment initiation to first root appearance, the average number of roots per leaf and the average length of roots per leaf have been noted for each leaf when treated for 24 hours in the different concentrations. The response in all these characters is greatly varietal. The leaves *Lantana camara, Doliehos Lablab, Canavalia ensiformis* and *Heliotropium indicum* were found to respond better than *Congea tomentosa, Malva viscus* and *Tropaeolum majus*. A very long period of 38 and 29 days were taken by *Congea tomentosa* and *Malva viscus* respectively for producing roots as against a 8-14 days period taken by other leaves. It is suggested that following this technique of maintaining detached single leaves quite green and fresh by its tuft of induced roots it is possible to study accurately the different metabolic processes going on inside the living cell.

19. Studies in the rooted leaves of *Ipomoea batatas*, Lamk.

B. SAMANTARAI and T. KABI, Cuttack 3.

Certain physiological and anatomical changes taking place in the rooted leaves of *Ipomoea batatas*, Lamk. were studied. The leaves of various ages were treated in different strength of aqueous solution of β-indolyl acetic acid (I.A.A.), β-Indolyl butyric acid (I.B.A.), α-Naphthalene acetic acid (N.A.A.) and it was found that the best rooting was by 2.5 p.p.m. (parts per million) of I.B.A. in the leaves taken from the 5th node from the apex. These rooted leaves were planted in soil and were found to exhibit secondary growth in the petioles and considerable expansion of the lamina. After these leaves grew in soil for a period of two months, an adventitious bud arises in the petiole of each such leaf and grows out to give a new plant whereas the original leaf dies out.

20. Response of *Dracaena angustifolia* twigs to synthetic hormones.

B. SAMANTARAI and H. PATTNAIK, Cuttack.

The rooting responses of cut twigs of a moncot plant *Dracaena angustifolia* was studied by applying aqueous solutions of β indolyl butyric acid (I.B.A.) of different concentrations to the twigs for 24 hours. Some twigs were kept dipped in water as controls. After few days it was observed that higher concentrations viz. 500 and 250 p.p.m. proved to be toxic and most of the cuttings rotted, as a result of which the number, length and weight of roots considerably went down. The optimum concentration of the hormone showing the best rooting was 100 p.p.m. The first roots emerged 18 days after treatment with hormone in this concentration as against 28 days in the controls. Lower concentrations from 50 p.p.m. downwards show a gradual decrease in their capacity to produce adventitious roots.

Histological studies of the cut twigs treated with 100 p.p.m. of hormone solution was made and sections were prepared after four day intervals. It was noted that only the cells just outside the stelar region are responsive and these gradually become meristematic as a result of hormone treatment ultimately producing root promordia, but other cells are not stimulated at all.

21. Anatomical Studies into the Machanism of Vernalisation, II. Anatomical Structure of Stems in Plants raised from Vernalised and Control Seeds.

S. C. CHAKRAVARTI, Agra.

Stem anatomy of the following treated and untreated plants has been worked out at various stages in their life-cycle:—

(a) *Brassica campestris* Linn. var. T. 102. (*b*) *Eruca sativa* Lam. var. Local. (c) *Lens esculanta* Moench. var. T. 4315-7. (d) *Cicer arietinum* Linn, var, T. 4, (e) *Lathyrus odoratus* Linn. var. Sutton's mixed. (f) *Pisum sativum* Linn. var, I, P. 29. (g) *Linum ussitatisimum* Linn. var. 477-3/2.

Stems of both vernalised and control plants have several layers of cambium in the vegetative stage. The activity of this cambium, however, gradually decreases till it is completely differentiated into xylem and phloem in the reproductive phase. Other changes accompanied with ageing are an increased thickening of the bundle cap cells, medullar ray cells, perimedullary zone and phloem, all of which take place earlier in the life-cycle of a treated plant.

It has been observed by certain workers that in photoperiodically induced plants the formation of flowering hormones and decrease in the cambial activity go together. In the vernalised plants, which always show normally active cambium, however, indicate that no such flowering hormone is produced during chilling. On the basis of the above observation and the results of previous investigation on mustard, the mechanism of vernalisation in this plant is suggested as follows:—

Low temperature treatment forms an autocatalytic thermo-stable substance 'A,' which increases with the period of chilling til the optimum is reached. This subsaance 'A' accelarates the synthesis of 'B' which on reaching optimum concentration in the shoot tip, either destroys the flower inhibiting substances or is itself changed into 'C', the flower forming substance. In control plants, 'A' is absent and synthesis of 'B,' therefore, takes place at a normal rate, for flowering to occur in due course.

22. The Origin and Development of Vegetative Axillary Buds in Dicotyledons.

G. C. MITRA, Calcutta.

Origin and development of vegetative axillary buds, of bud traces and the differentiation of procambium in the bud traces and in the leaf traces of the bud have been studied in three species viz., *Eupatorium ayapana* Vent., *Jasminum flexile* Vahl. and *Morus alba* Linn. having different phyllotaxy and nodal topography.

The vegetative shoot apex in the three species consists of two tunica layers and a corpus beneath them. The leaf primordia are formed in decussate pair on the shoot apex of a mature shoot of *E. ayapana* and *J. flexile*, whereas they are formed in alternate 2/5 th phyllotaxy on the shoot apex of mature shoot of *M. alba*. The node is trilacunar in *E. ayapana*, and *M. alba* and is unilacunar in *J. flexile*.

In the three species a group of meristematic cells of the bud primordium originates from the apical meristem as a "shell zone" at the axil of the second primordium below the apex. These bud initials are stained darkly like the apical meristem and are small in diameter. They can be easily recognised from the somewhat vacuolated surrounding cells. The two tunica layers are continuous in the axillary bud apex and its corpus is derived from the peripheral zone of the main axis. The bud protrudes as an elevated mound by divisions in a variety of planes of the bud initials. Enlargement and vacuolation of cells cause the formation of cortex and pith of the protruding bud. Within the bud primordium procambial connection develops acropetally from the axial stele at the node. The bud primordium increases in size, acquires organization characteristic of an apical meristem, and produces cataphylls and foliage leaves in an orderly sequence. Different stages of growth and differentiation of the bud primordium have been described.

The bud traces in *E. ayapana* and *J. flexile* from an annulus of procambium below the apical meristem of the bud but at lower levels the annulus of procambium becomes two crescentric arcs whereas in *Morus alba* the annulus of procambium at lower levels becomes an open cylinder of procambium whose two open end face the bud gap. The bud gap occurs only in *M. alba*, The bud gap in *Morus* can be correlated with the phyllotaxy but this needs confirmation from further studies in other materials.

Count of mature protoxylem cells is largest near the bases of the bud and successively smaller nearer the tip. Protophloem also appears to be progressively fewer in number at successive levels from the base. The older bud leaves had more mature protoxylem and protophloem elements than the successively later appearing ones. It may be said that in these three species the differentiation of protoxylem and protophloem develops acropetally into the leaf traces of the bud primordia.

23.. Abnormal medullary bundles in the stem of *Argyrei, speciosa.*

B. M. JOHRI, Delhi.

Pieces of the stem of *Argyreia speciosa* collected in 1948 from the Botanical Garden of the Forest Research Institute, Dehra Dun, showed abnormal medullary bundles.

A cross section of the stem shows the usual ring of vascular tissue with well developed secondary xylem and phloem as well as patches of intra-xylary pholem. Prominent laticferous ducts and sphaeraphides are distributed through the cortex and pith. The medullary bundles are usually collateral and open and are capable of a small amount of secondary growth. The peripheral bundles which lie in close proximity to the intraxylary phloem are usually inversely oriented or obcollateral i.e., xylem faces outward and phloem towards the pith. Occasionally amphivasal bundles are formed and those stiauated towards the centre are collateral or bicollateral. In older stems the inner pholem of the bicollateral bundles is much better developed than the outer.

24. The organization of the shoot apex in *Asparagus recemosus* Willd, and *Agave mexicana* Lam.

I. BANERJI, Calcutta.

The nature of the cellular organization of the shoot apex of *Asparagus racemosus* and *Agave mexicana* was studied from vegetative shoots of the former plant and from bulbils of the latter. In both the plants the presence of a biseriated tunica and a zonated corpus were noted. No variation in the number of layers of the tunica was observed. The absence of foliar foundation is a conspicous feature. The initiation of the foliage leaves in noted in the second layer of the tunica and that of the bud primordia in the cells of the outermost layer of the peripheral layer of the corpus. The axillary buds appear to develop from a portion of the apical meristem located in an adaxial position of each leaf primordium. The origin of the provascular strands is acropetal.

25, Vascular Anatomy and Inferior Ovary.

V. PURI, Meerut.

Morphological nature of the "Wall" of the inferior ovary has long remained a controversial problem. While most authors seem to agree on interpreting the internal region as truly carpellary, opinion is sharply divided as to the nature of the nature of the outer region of the "Wall." Some of the authors describe it as 'foliar' while others interpret it as 'axial.' Evidence from different fields of study has been brought forward to support one view against the other. During recent years the course and disposition of vascular bundles in the ovary wall have been called upon, as it were, to support the 'foliar' view. A critical examination of the recent literature on this aspect of the subject has revealed to the author that in majority of cases the evidence brought forward by floral anatomists in support of the 'foliar' view is not convincing. In fact the present author is inclined to believe that anatomical method is of little use in solving the problem of the inferior ovary. We have to look to some other fields of study for the solution of the problem if it still exists.

26. Cytogenetical studies in Musaceae. VI. Fragmentation of Chromosomes as a Physical Basis of Speciation in the Genus *Strelitzia*.

A. K. CHAKRAVORTI, Calcutta.

Out of the 4 species of the genus *Strelitzia* Banks., the karyotypes of 2 species, namely, *S. Reginae* Banks. and *S, augusta* Thunb, have been analysed, It has been observed that in addition to the difference in the chromosome number of these two species, there is also remarkable contrast with respect to the morphology of their chromosome complements.

The $2n=14$ chromosomes of *S. Reginae* and $2n=22$ of *S. augusta* could be classified into 8 morphologically distinguishable types. Of the 8 types, designated by the letters A to H, both the species have 5 types in their somatic complements *S. Reginae* possessing the types A, B, C, D and H, while *S. augusta* shows the types E, D, F, G and H.

The chromosomes of *S, Reginae* are in general longer and have many supernumerary constrictions,, and those of *S. augusta* are much shorter with very few supernumerary constrictions. Further, the long chromosomes with supernumerary constrictions (A, B and C pairs) which are so characteristic in *S. Reginae* are altogether absent in *S. augusta*, On the other hand, the types E and F which are characterised in having one of their ends drawn-out into a fine thread-like projection, found in *S. augusta* are entirely absent in *S. Reginae*. Such contrasting structural differences in the chromosomes of the two allied species have been explained as due to fragmentation of three pairs of chromosomes, AA, BB and CC of *S. Reginae* across all the secondary constrictions on them, while giving origin to species, like *S. augusta*. It has been found that the altered karyotype of *S. Reginae* derived on the assumption of breaks at two loci on each of its A chromosomes and at one on each of its B and C pairs, fairly corresponds to the karyotype of *S. augusta*.

The possibilities of an acentric fragment surviving and functioning as a normal chromosome have been discussed. It has been suggested that primitively the centromeric function of a chromosome was carried out by the whole chromosome. Or, in other words the centromere was diffuse in nature in a primitive chromosome. Later, on the advancement of evolution centromeric function has been localised in a centromerin apparatus on the body of a chromosome.

27. Cytogenetical studies in Zingiberaceae.

A. K. CHAKRAVORTI, Calcutta.

Cytogenetical studies have been carried out in 4 species of *Zingiber*, namely, *Z. cassumunar* (2n=22), *Z. officinale* (2n=22), *Z. zerumbet* (2n=22) and *Z. rubens* (2n=22), in 4 species of *Alpinia*, namely *A, alughas* (2n=48), *A. bracteata* (2n=48), *A. calcarata* (2n=48), and *A. nutans* (2n=48), in one species of *Elettaria*, namely, *E. cardamomum* (2n=52), in 4 species of *Kaempieria*, namely, *K. atrovirens* (2n=22), *K. rotunda* (3n=33), *K, Gilberti* (3n=33) and *K. cienkowskya* (2n=28), in 5 species of *Curcuma*, namely, *C. amada* (2n=42), *C. aromatica* (2n=42),, *C. angustifolia*, (2=42), *C. longa* (3n=63) and *C. zedoaria* (3n=63) in one species of *Globba*, namely, *G. bulbifera* (3n=48) and in two species of *Costus*, namely *C. speciosus* (2n=36) and another undetermined species (2n=44).

All the genera, excepting *Curcuma*, are characterised in having unusually large number of constructions on their chromosomes. For example, in *Z. cassumunal A. calcarata*, *K. atrovirens*, *E. cardamomum* and in the undetermined species of *Costus*, the number of constrictions varies between 54 and 70, over and above the kinetic ones. Determination of the maximum number of nucleoli in the tetrad nuclei of the PMCs indicates that quite a large number of these constrictions, and very likely all of them, are nucleologenic. *C. speciosus*, for instance, having 52 nucleolar constrictions including satellites, shows 25 nucleoli of various size classes in its haploid nuclei of pollen tetrad. With respect to such exceptionally high number of nucleolar constrictions, Zingiberaceae parallels Musaceae. It has been suggested that all constrictions save the centromeric ones are nucleolar.

The lowest 2n numbers of chromosomes of the different genera examined uptil now, are 22 for Zingiber and *Kaempferia*, 18 for *Costus*, 48 for *Alpinia*, *Globba* and *Phaeomeria*, 52 for *Elettaria* and 42 for *Cureuma*. These numbers suggest aneuploidy in the family. But this aneuploidy is not due to hybridization, nor is it due to multiplication of chromosomes. On the contrary, this has been attributed to the origin of the higher chromosomed complements from the lower chromosomed ones, in consequence to fragmentation of certain chromosomes across the secondary constriction regions. Evidences indicate that species like *Alpinia*, *Curcuma* and *Elettaria* with higher chromosome number and shorter chromosomes (0.7μ-2.6μ) with fewer supernumerary constrictions originated from species like *Zingiber* and *Kaempferia* having lower chromosome number but longer chromosomes (1.4μ-6.7μ) with many supernumerary constrictions, as a result of break across the supernumerary constrictions on the chromosomes of the latter group. This contention is further supported by the fact that in many chromosomes of the derived forms there is a thread-like projection resembling a secondary constriction thread, at one or both ends. These thread-like structures appear to be a portion of secondary constriction threads across which fracture has been assumed. It has been claimed that species with long chromosomes provided with a high number of supernumerary constrictions are labile, having the potentialities of throwing out new forms spontaneously through fragmentation across the constrictions followed by recombination.

Cytological features of the different species corroborate the subdivision of the family, Zingiberaceae into 4 tribes, namely, **Costeae, Hedychieae, Globbeae and Zingibereae** as adopted by the taxonomists.

28. Isochromosomes in Tomato.

NIRAD SEN, California, Berkeley.

Two tomato plants were obtained in which one of the normal chromosome was replaced by an isochromosome at the diploid level. One of the isochromosome was composed of the two long arms of chromosome 9 and that of the other of the long arms of chromosome-8.

The two arms of the isochromosomes paired with each other or one of the arms paired with the homologous arm of the normal chromosome to varying lengths. Unpaired segments of both chromosomes either remained single or showed some non-homologous pairing in the chromatic zones. At diakinesis the isochromosome appeared ring shaped if a chiasma occurred between its two arms. Precocious movement at the first metaphase, lagging chromosomes at anaphases and precocious division of the lagging chromosomes at anaphase I were common meiotic irregularities.

One of these mutants on selfing produced three types of progenies: (i) normal plants, (ii) secondary trisomes, and (iii) isochromosomal disome like the parent, the last in an extremely small percentage. The secondary trisome on selfing produced (i) normal plants, (ii) secondary trisomes and (iii) primary trisomes: while a fourth type: the isochromosomal disome is expected when a large progenies will be grown.

Different types of trivalent configurations at pachytene and at diakinesis of the secondary trisome were observed.

29. On some interesting Jurassic woods from Rajmahal Hills, Bihar.

D. C. BHARDWAJ, Lucknow.

Towards the end of December, 1948, the late Professor B. Sahni, and others collected a large number of Jurassic fossil woods from a number of localities, in Rajmahal Hills, Bihar. Only a part of this collected from Amarjola and Kulkipahar, is under investigation for the present. The following woods have been indentified to belong to a number of genera:—

(1) *Taxoxylon* Unger (i) *T. indicum* sp, n.

Diagnosis:—Growth rings regular, pith eccentric; **Autumn wood** 6-8 tracheides wide, squarish to sub-rounded, thickwalled elements, 20 × 12-15 μ. **Spring wood** 20-40 tracheids wide, pentangular, less thick walled elements 20-24 in dimeter. Tracheids 1.5-2 mm. long, uniseriate bordered radial pits. Spiral thickening in 2 series, 45°-10° inclined, resinous tracheids with resin plates abundant. **Wood parenchyma and Resin canals** absent. Tangential pitting absent. **Medullary Rays** uniseriate, 1-6 cells, thick walled, field pits 1, rarely 2, cupressoid; Ray tracheids absent.

(ii) *T. rajmahalense* sp. n,

Diagnosis:—Growth rings irregular, pith eccentric; **Antumnwood** 8-10 tracheids wide, thick walled 22-26 μ × 14-16 μ elements; **Spring wood** 20-30 tracheids wide, thick walled 26-35 μ × 22-26 μ elements. Tracheids 1.2 mm. long walls, 4-5 μ thick, uniseriate bordered pits concentrated nearer the ends, spiral thickening in crowded 2 series, 10°-90° inclined; **wood parenchyma and Resin Canals** absent. Tangential pitting absent. **Medullary Rays** uniseriate, 1-6 cells, thin walled, field pits 3-6, cupressoid or simple. Ray tracheids absent.

(2) *Mesembrioxylon* sp.

(3) *Taxodioxylon* sp.

(4) *Homoxylon rujmahalense* Sahni.

Several others are not very well preserved to permit precise identification and hence are included in *incerti cedis*. *Taxoxylon* is recorded from Jurassic and from India for the first time and is represented by two new species. *Mssembnoxylon* and *Taxodioxylon* have but one species each. *Homoxylon* is again reported from the Jurassic beds of Rajmahal and is undoubtedly a Jurassic type.

30. Some Angiospermic Plant Remains from the Tertiary beds of the Garo Hills, Assam.

R. N. LAKHANPAL, Lucknow.

A colleceion of fossil plants made by Sir Cyril S. Fox from Tertiary beds 500 yards south of Damalgiri bungalow in the Garo Hills,, Assm is described. The collection mostly consists of dicotyledonous leaf impressions.

A short account of the previous palaeobotanical work on the Tertiary rocks of Assam is given.

The following plants have been identified and described:—

Trema garoensis sp. nov. *Nelumbo* sp. *Neolitsea Sahnii* sp. nov. *Laurophyllum* sp. *Grewia argentioides* sp. nov. *G. archaeocolumnaris* sp. nov. *G, garoensis* sp, nov, *Bombacites orientalis* sp. nov. *Vatica* sp,, *Shorea burmindica* sp, nov, *Phyllites grewioides* sp. nov. *P. obovatus* sp. nov.

A few more leaf impressions are described but, due to lack of sufficient data, their identification is not possible.

Distribution of comparable modern and fossil plants is also given.

Ecological conditions indicated by the plants recognised in the collection are discussed on the basis of the habitats of the modern equivalents as well as on the indications of the leaf characters. The flora seem to represent conditions somewhat similar to those met with in the Eng. Forests, a section of the Burmese deciduous forests, composed chiefly of Dipterocarps and jutting out into the evergreen forest zone around them.

Under considerations of distribution and migration, the flora seem more naturally to have belonged to Eastern India from where the majority moved southeastwards into Burma and Malayan region, some to Southern India while quite a number persisted in the original habitats.

The collection comes from the Kopili stage of the Tertiary beds of Assam for which an early Tertiary age (Middle or Upper Eocene) in indicated by the fossils.

31. Megaspore and other Plant Remains from lower Gondwana of Singrauli Coal Field, district Mirzapur, U.P.

B. S. TRIVEDI, Lucknow.

Nine species of *Triletes*, seven of which are new, two new species of *Cystosporites*, one well preserved, one species of *Sporites* and three probable have been described in this paper. *Triletes* is used here in the sense employed by Schopf (*vide infra*), *viz.*, it is a name employed for fossil megaspores which probably belonged to Lycopodiales and each one of which had a tri-radiate mark.

The present discovery of a large number of megaspores of *Lycopodium* clearly proves that Lycopods must have been present quite in profusion to contribute their share in the formation of coal, though they have been completely absent in the Palaeozoic with the exception of *Bothrodendron* in India. That these megaspores belonged to Lycopodiales is beyond doubt.

It has been a belief that *Glossopteris* flora on the hand and flora dominated by *Lepidodendron* and *Sigillaria* on the other were spatially separated; but the passage of time " permitted a co-mingling of a *Lepidodendron* with a *Glossopteris* flora in South America in upper Palaeozoic times." These discoveries along with those of Mehta, Pant and Saxena conclusively prove the existence of Lycopods along with *Clossopteris* in the Palaeozoic era of India.

Another and interesting feature is the discovery of *Cystosporites* of which one is definitely a new species. As the coal from which these have been obtained is of Barakar age (Lower Permian) we have here for the first time their extension from Carboniferous to Lower Permian.

32. Variations in conidial character of *Helminthosporium oryzae* Breda de Haan.

S. B. CHATTOPADHAYAY and N. K. CHAKRABORTY, Calcutta.

Variations in shape and size of conidia of *Helminthosporium oryzae* Breda de Haan has been observed by various workers in different parts of the world and consequently there is a belief that different geographical races may be present. Dreschler was of opinion that Japanese and American strains are identical, the conidia being slightly curved, cylindrical to elliptical, widest at the middle, tapering towards both ends, more towards distal than proximal. Nisikado remarked that

Japanese strain is different from American one in having obclavate conidia, rounded at the base, tapering towards open and with conspicuous, protruding hilum. Indian strain described by Mitra resembles Japanese one in certain gross morphology but for the inconspicuous hilum. In West Bengal, the present investigators have noted three different types with distinctive characters of conidia:— (i) 24—156 μ × 8—22 μ conforming to American strain the common type found, (ii) 45—89 μ × 14—22 μ — 4—7 septa-resembling Japanese type in shape, but shorter in size and there is less variation in size and also septation and quite different from type I, J, (iii) a third type 41—88 μ × 8—15 μ resembling type II in size, but in shape more or less identical with type I may be a shorter form of common type I.

33. Selection of better strains of *Aspergillus niger* for the production of citric acid from sugars.

Miss C. DAS GUPTA, Miss S. BARUAH and P. NANDI, Calcutta.

Sixty strains of a *Aspergillus niger* were isolated from soil dilution plates and preliminary tests were made. They were grown in liquid sucrose ammonium nitrate medium (pH 2.0) and the fermentation was continued in each case for 10-12 days. As routine work, titrable acidity and pH of the culture filtrate were recorded everyday. The residual sugar and the dry weight of mycelium were determined at the end of the experiment. A great specificity of strains of *A. niger* was observed regarding their ability to synthesise citric acid from sugar as the source of carbon. Of the whole lot, 9 strains were finally selected for detailed study. The work is progressing.

34. Studies on pH conditions for the growth of rice-inhabiting fungi.

JAGAT JIBAN GHOSH, Calcutta.

The effect of pH on the growth of 15 isolates of rice-inhabiting fungi was studied on Czapek's agar (containing 5%glucose) and on rice-decoction agar. Growth rate was studied by measuring colony diameter after 4 and 9 days incubation at 30° ± 1°C. The pH optima of the majority of the rice-inhabiting fungi studied, were found to lie near 5.5 to 6.0. All the *Mucor*, *Fusarium*, *Cladosporium* and *Alternaria* species tested, exhibited best growth near about pH 5.5. In general, the growth of the rice-inhabiting fungi was found to be more vigorous in acidic pH of the media than in alkaline pH.

35. Effect of temperature on the growth of the rice-inhabiting fungi.

JAGAT JIBAN GHOSH, Calcutta.

The effect of temperature on the development of mould growth on stored ricegrains was studied by (a) exposing different samples of ricegrains to varying humidities **viz.** 70% to 100% at 22°C, 25°C, 30°C, 35°C and 40°C ± 1°C respectively and examining for the appearance of mould growth and (b) by measuring the increase in the size of colonies of each isolate of rice-inhabiting fungi on Czapek's agar and on ricedecoction agar, kept at different temperatures. *Aspergillus* species, in general, showed best growth at the temperature range of 30°C to 35°C.

Most of the *Penicillium* species, exluding *P. purpurogenum* exhibited their optimum growth near 30°C but on rice decoction agar, they exhibited a preference for lower temperature. The *Mucor* species and *Fusarium* species had their optimum temperatures for growth above 30°C and near about 35°C on the media *viz.*, Czapek's agar and rice decoction agar. *Cladosporium* sp. and *Alternaria* sp. appeared to thrive best at lower temperature *viz.* near about 25°C. In general, at higher temperature, mould growth was found to be very vigorous on most of the rice samples studied.

36. Trial of different fungicides for control of early blight disease of potato caused by *Alternaria Solani* (E. and M.) Jones and Grout.

S. B. CHATTOPADHAYAY, Calcutta.

In the plains of West Bengal, potato suffers from a serious fungal disease—early blight caused by *Alternaria solani* (E. and M.) Jones and Grout. The disease appears annually from mid-January, affecting mainly the late crop which covers a much larger area and is used for building up stocks. It is estimated that approximately ten percent of the total yield is lost due to the attack of the pathogen. Timely application of protective fungicidal spray on the crop can save it from the attack of the pathogen. To choose the most effective fungicide, experiment was undertaken on Darjeeling Red Round variety of Potato for three consecutive years, in Maynaguri farm with four fungicides namely Perenox (a proprietory Copper fungicide at the rate of 4 lbs. per 100 gallons.), Soltosan (a proprietory copper fhngicide at the rate of 6 lbs. per 100 gallons), Bordeaux Mixture (1%), Dithane-Z-78 (Zinc-ethylene-bisdithiocarbamate) at the rate of 1½ lbs. per 100 gallons). Three applications at fifteen days interval were given. Results of the experiment show that all the fungicides were effective in disease control. The best and consistent performers are Perenox and Soltosan, then comes Dithane-Z-78 and last in the series is Bordeaux Mixture.

37. Assessment of Infection of *Helminthosporium Oryzae* Breda de Haan on Paddy.

S. B. CHOTTOPADHAYAY, Calcutta.

'Sesame leaf spot' of Paddy caused by *Helminthosporium oryzae* Breda de Haan occurs in two well marked phases:—Seedling or primary confined to seedling stages and secondary confined to post-tillering stage. Primary infection is due to presence of pathogen in the seed and can be controlled by use of seed treating chemicals. Disease in the subsequent stages is due to infection of airborne conidia and can be controlled by use of resistant varieties. While testing varieties for resistance to infection, a standard method has been evolved to compare the reaction of different varieties to attack of *Helminthosporium oryzae*. According to this, observations are recorded on three stages of growth of paddy, namely pre-emergence, post-emergence and maturity in the following way:—In pre-emergence stage-average leaf infection is noted by comparing the infected leaves 4-5 lots of 50 leaves per 1/60th acre area with a standard infection chart; **in post-emergence stage,** average leaf area infection and percentage of sterile ears. if present, in ten lines at random; **in mature stage,** the percentage of spotted fertile and spotted sterile and spotless infected grains is recorded of 10-15 earheads collected at random from 1/60th acre area.

38. Trial of different Seed treating Fungicides for control of primary seed borne Infection of *Helminthosporium oryzae* Breda de Haan.

S. B. CHATTOPADHAYAY, Calcutta.

Helminthosporium oryzae Breda de Haan, causal organism of 'Sesame leaf spot' disease of paddy is primarily seed-borne. Previous experiments in connection with control of the disease have shown that best results are obtained by keeping seeds in hot water at 52°-55°C. for five to ten minutes after presoaking for a few hours. This method is too cumbersome to be adopted for large scale use. Trials have been undertaken with a number of seed treating dust fungicides in use for control of seed-borne diseases, namely Agrosan GN, Agrosan GN5, Certosan, Landisan, Aagrano, Tillex, Arasan, Phygon and Yellow Cuprocide. Seeds of seven different varieties of paddy, namely Tilakkatchery, Asra, Latisail, Patnai, Bhasamanik, Kalamkati and Badkalamkati were treated with these chemicals (in the rate of 1 : 300 ; 1 part of chemical with 300 parts of seed, except in the case of yellow cuprocide where the ratio was 1: 600 and in the case of Agrosan GN5 1: 1200) and were grown both under field and laboratory conditions. Data obtained from these experiments point out that treatament with Agrosan GN and Agrosan GN5 has given consistent and most promising results in respect of increase in stand as well as control of disease, while others have not been found effective in all cases under study.

39. Observations on the incidence of stem rot of Jute Caused by *Macrophomina phaseoli* (Maubl.) Ashby.

S. B. CHATTOPADHAYAY, S. K. SENGUPTA, N. P. DAS and P. BASU, Calcutta.

Jute in West Bengal suffers from a serious fungal disease, *viz.* stemrot of Jute caused by *Macrophomina phaseoli* (Maubl.) Ashby. This disease often causes great loss by affecting both yield and quality of the fibre. The pathogen remains both in the seed and in the soil. Control of the disease by use of clean seeds is not feasible owing to obvious difficulties and external treatment is not of much value as the pathogen is deepseated. It has been observed that where Jute in Khariff is followed by potato in the rabi, incidence of the disease is high. Where potato is not grown in winter on Jute lands, disease has been found to be much less. Cultivation of Jowar *(Sorghum vulgare)* instead of Jute in the Khariff for a year has given good results. Application of lime at the rate of 3 cwt. per acre and adequate quantity of potash manures along with nitrogenous ones have been observed to give good results in the control of the disease.

40. Sclerotial disease of *Orobanche cernua* Loefel.

M. J. NARASIMHAN, Patna, Bihar.

Orobanche cernua Loefel. occurs in abundance during the winter months, parasitic on brinjal, tomato and mustard plants. A serious sclerotial disease of *O. cernua* was observed in Patna and the neighbouring villages. In restricted places the disease was severe and exterminated the *Orobanche.* So far as the observations go, the host plants on which the *Orobanche* was parasitic were not in any way affected by the fungus.

The *Orobanche* plants were first attacked at the soil level. The cortical tissues were rapidly invaded without showing any external symptoms at first, until a sudden collapse of the plants followed. The white cottony extramatrical mycelium of the fungus bearing numerous black sclerotia can be observed on the diseased plants.

The fungus was isolated in pure culture and studied. It produces cottony mycelial growth, developing large black sclerotia 3 to 5 mm. in diameter along the margin of the Petri dish. Temperatures between 16-20°C. were found favourable for the fungal growth.

Sclerotia were collected and buried in moist sterile sand and incubated at 16°C. temperature. They germinated after 10 days by the formation of numerous stipes which elongated rapidly. These aborted away in due course without apothecial formation. The fungus is tentatively referred to *Sclerotinia sclerotiorum* (Lib.) de Bary.

41. Chitri Disease of Tobacco in Gujerat.

N. PRASAD and I. M. PATEL, Anand.

Chitri disease of tobacco has been recorded as wilt caused by *Fusarium Oxysporum* v. *nicotianeal.* Detailed examination of diseased plants shows that wilting is accompanied by retting of cortical tissues of the roots. The fungus mycelium is present both in vascular and parenchymatous tissues as well.

Isolations yielded 50 different strains of *Fusaria.* Out of these 9 cultures caused typical wilt while 3 cultures produced root rot.

Taxonomic study placed the wilt producing strain under *F. oxysporum* f. *nicotianeal* Snyd. et. Hans. while the strains which caused root rot. under *F. Solani* f. *nicotianeal* Snyd. et. Hans.

42. Studies on the charcoal rot disease of potatoes in Bihar.

M. J. THIRUMALACHAR, Patna.

Charcoal rot is a major disease of potatoes in Bihar, incited by the fungus *Macrophomina Phaseoli* (Maubl.) Ashby, Infected tubers show blackening of the flesh, emitting a bad odour. The damage ranges from 5 to 100 per cent. depending upon the predisposing conditions. Study of the fungus in artificial culture has revealed the occurrence of two cultural types, one identical with the sub-species *typica* already known on potato and the other resembling sub-species *Sesami* described on *Sesamum,* Tuber inoculation from artificial cultures produced the disease within 6 days at room temperature (20-24°C). Stem inoculations with the pathogen produced cankering, breakdown of the pith resulting in hollow stem, and abundant formation of pycnidia on the cankered surface.

Field experiments laid to find out control measures indicated that under conditions prevailing in Bihar, early planting (during the first and second weeks of October) and harvesting before the middle of March, gave maximum yield and reduced charcoal rot incidence at the time of harvest and subsequent storage (less than 10% loss). The fungus is activated by warm soil temperature conditions, and in harvests made in April and after, more than 60% of the tubers rotted. Early lifting before the end of March is therefore advisible for late planted (last week of November) crop as it ensures comparatively high yield and reduction in disease incidence. Clonal lines of the South American species *Solanum chacoense* has been found to be highly resistant and even immune to charcoal rot disease.

43. Dry rot of tubers and sprout injury in potato incited by *Aspergillus* sp.

M. J. THRUMALACHAR and C. S. RAMAURTHI, Patna, Bihar.

During the humid months of July-September, dry rot of tubers and sprout injury incited by a species of *Aspergillus* was noticed in the storage godowns of the cultivators in Patna City and at the Central Potato Research Institute farm. The dry rot produced by the fungus was similar to that incited by *Fusarium coeruleum* (Lib.) Saac., the diseased portions shrinking and causing the formation of hard depressed areas with concentric ridges. The fungus penetrated into the tuber only through bruises and ruptured skin. The first indication of the dry rot symptom on the inoculated tubers was noticed after 6 to 10 days. Sprout injury was caused by the rapid growth and killing of tissues by the fungus. The leaf primordia at the tip were killed at first and the infection gradually progressed downwards. In artificial inoculations, the sprouts ½ to 1″ long were killed within a week, the fungus penetrating into the tissues even without wounding.

The colonies of the fungus on artificial media are slow growing, avellaneous, cinnamon-yellow. The conidial heads bear phialides in two series and globose condidia. Further studies on the aetiology and the identity of the fungus are in progress.

44. Studies on the isolation of *Azotobacter* in several samples of cultivated soil.

Miss PREETY CHAKRABARTY and P. NANDI, Calcutta.

Samples of soils collected from gardens and cultivated fields were plated out with mannitol-phosphate agar containing congo red (1: 400,000) for isolation of *Azotobacter*. *Azotobacter* was found to be abundant in these soils. All the 3 sp. of *Azotobacter* eg., *Az. agile*, *Az. chroococcum* and *Az. indicum* were present. 7 strains were selected for the study of their physiological activities: *Az. indicum* was found not to grow well in nutrient broth with or without any glucose, sucrose or maltose; on litmus milk the colour changed in two days. On potato medium it becomes yellow and on plain washed agar it fails to grow at all.

45. Antibiotic activities of some micro organisms isolated from Bengal.

N. K. CHAKRABORTY, P. BASU and P. NANDI, Calcutta.

Samples of soil collected from Southern West Bengal were plated out with Waksman's agar and Thornton's medium for isolation of fungi and actinomycetes. The isolated fungi were grown on 50 ml. (Zapek-Dox medium with 0.2% malt extract in 250 ml flasks and assayed for antibiotic activities by the agar-cup method using *Staph. aureus* as the test organism. Out of 76 isolates 45 were capable of producing inhibitory substances and 27 had moderate antibiotic properties. 67.5% of the *Aspergilli* and 50% of the *Penicillia* were inhibitory.

The antibiotic activity of the actinomycetes were tested by the cross-streak method with *Staph. aureus. E. coli*, *Eb*, *typhosa* and *V*, *choleraae* as the test organisums. Of 40 actinomycetes tested 17 were inhibitory. It is concluded that antibiotic producing micro-organisms are fairly well distributed in the soils of these regions of West Bengal.

46. Use of Sodium propionate in the isolation of soil Actinomycetes.

S. K. MUKHERJEE and P. NANDI, Calcutta.

Sodium propionate has been recommended for use in the isolation of soil actinomycetes. Soil samples rich in microflora were plated out at different dilutions with various concentration (0.1—0.6%) of sodium propionate and controls were maintained. However it was found that this substance acts as a general inhibitor and does not ordinarily act selectively on a particular group of organisms.

47. Inhibition of *Rhizobium* and *Azotobacter* by Antibiotic Producing Soil Fungi.

S. SEN and P. NANDI, Calcutta.

Earlier investigations have revealed that antibiotic-producing fungi are widely distributed in Indian soils and the inhibitory activity of 40 such positive strains towards *Rhizobium* and *Azotobacter* has been studied.

Eight strains each of *Rhizobium* representing different cross-inoculation groups and of *Azotobacter* representing all the 3 sp. of *Azotobacter* known to occur in India were used as test organisms. The cross-streak method of assay was followed. Each fungus was grown on one-third of a Czapek-Dox-malt-agar plate and its antagonistic activity tested by streaking the strains of *Rhizobium* and *Azotobacter* (as the case may be) on the remaining portion of the plate containing mannitol agar. The results indicate that 40% and 62.5% of the fungi were inhibitory to at least one strain of *Rhizobium* and *Azotobacter* respectively.

The *Azotobacters* were more sensitive than the *Rhizobia*. Of the 3 sp. of *Azotobacter Az. indicum* seems to be the most resistant. *Az. chroococcum*— which is abundant in Indian soils is fairly sensitive to the inhibitory action. More than 30% of the fungi inhibit at least one of the five strains. The sensitivity however varies from strain to strain. Among the *Rhizobia*, *Gram* and *Lathyrus* are fairly sensitive and *Cajanus*, *Lentil* and *Lupin* strains are the most resistant.

The soil microflora of West Bengal are largely dominated by antibiotic-producing *Penicillia* and *Aspergilli* and the role of these and other antagonistic soil fungi in the nitrogen economy of the soil in discussed. It is suggested that the absence of nodules on some leguminous plants in certain soils may be due to the inhibitory activity of the antagonistic soil micro-organisms.

48. The origin and development of the shoot apex in *Equisitum debile.* Roxb.

SUDHIR KUMAR BANERJI and GIRIJA PROSANNA MAZUMDAR, Calcutta.

The origin, growth and development of the apical meristem of *Equisitum debile* has been studied. The apical cell which is a single triangular cell of unequal sides varies in size as per the size of the shoot apex. The apical cone which is a product of the divisions of the apical cell is responsible for the development of the leaf sheath. By the division of the apical cell three segment cells are produced at the beginning and again by divisions the sextant cells are produced. The whorled and alternate arrangements of the leaves and the variations in the number of leaves at differant nodes in the same branch has been recorded. The procambium strand consisting of elongated cells with deeply stained nuclei extending from the third leaf whorl to downwards has been noted and the differentiations of the procambium strains into the vascular elements has been studied.

49. The origin and development of the shoot apex in *Lycopodium phlegmaria*, L.

SUDHIR KUMAR BANERJI and GIRIJA PROSANNA MAZUMDAR, Calcutta.

The origin, growth and development of the shoot apex of *Lycopodium phlegmaria* has been studied. The formation of the apical cone starts from a number of cells which are situated a little below the upper end of the cone. The gradual differentiations of the procambium strands has been studied. The formation and development of the leaf primordium which is ultimately cut off from the main bulk of the meristamatic and undifferentiated stem region has been studied.

50. "Cytological studies of a sterile diploid Eumusa" 1 Safet-velchi.

S. GOVINDASWAMY, Poona.

During the study of the somatic chromosomes of some of the cultivated varieties of Bombay, it was noted that a good table variety **Safet-velchi,** has the chromosome number $2n=22$ and is thus a sterile diploid. The meiosis of this plant is presented here.

Owing to their smallness the meiotic chromosome could be studied only from diakinesis onwards. During diakinesis, besides bivalents, univalents in various numbers are present. In extreme cases, as many as 22 univalents may be counted indicating the complete failure of pairing. One trivalent is also often found.

Metaphase plates with typical bipolar spindles are rarely met with. It is usual to find 7 bivalents or 5 bivalents and 1 trivalent along with 8 or 9 univalents, which are spread haphazard on the spindle.

A sharp differentiation between metaphase and anaphase is absent in many cases. Occasionally P. M. 6 containing a chromatid bridge and fragment at anaphase I are seen, indicating inversion and structural alterations of the chromosomes. The chromosome movement during anaphase is irregular. The univalents are included in that pole near which they happen to be at the time of telephase. In many cases one of the divisions fail, so that second division metaphase plates are rather rare. In cells where the second division takes place, the chromosome distribution is highly irregular. Apart from this, lagging chromosomes form micro-nuclei in the cytoplasm leading to the formation of more than 4 microcytes. The pollen grains degenerate. The pollen is 95 to 98% sterile.

These observations lead to the inference (i) that **Safet-velchi** is a hybrid between two distantly related diploid types, whose chromosomes are not homologous enough for complete pairing or (ii) that some of the chromosomes may have undergone structural alterations and lost their capacity to pair during the course of cultivation.

51. Pharmacognosy of Indian Bark drugs.

S. C. DATTA and B. MUKERJI, Calcutta.

A large number of barks of Indian medicinal plants are sold in the market as crude drugs and these are used by the manufacturers and practitioners for preparation of pharmaceutical and indigenous products. The identity of these barks from commercial samples appears to be difficult to determine, as most of them look alike in dried condition, and this often leads to confusion, adulteration and substitution of the samples. In the present work the authors have dealt with the pharmacognostic characters of these barks, obtained from 50 different medicinal plants of Indian origin, and have described their identifying characters in detail The work also includes a map which shows the distribution of these drugs in India and it contains information on synonyms, vernacular names, source, habitat, standard, characters of drugs and their powders, chemical constituents and their uses. A chart of microchemical reactions, as well as analytical key of the powdered drugs based on anatomical characters has also been appended in the work.

52. Effect of different physiological factors on the growth and alkaloid content of *Datura metel* Linn.

RAI H. N. CHAUDHURI and S. C. DATTA, Calcutta.

In this paper the authors discuss the results of first year's observations of the influence of (1) Effect of cuting the top, (2) Effect of time of collection, (3) Effect of time of sowing and (4) Effect of vernalization on the growth and alkaloid content of *Datura metel* Linn.

53. Comparative anatomical studies on Indian Cinnamon barks.

D. DATTA, Calcutta.

The author records the anatomical details of the barks of *C. camphora* Nees., *C. iners* Reinw *C. zeylanicum* Breyn., with a view to bring out diagnostic characters which can be considered of value in distinguishing the crude drugs from dried and powdered samples.

64. Pharmacognostic studies on *Euphorbia pilulifera Linn.*

D. DATTA and RAI H. N. CHAUDHURI, Calcutta.

This annual herb is profusely found in India and is considered a useful remedy in dysentery, colic, and respiratory diseases. The pharmacognostic characters and chemical constituents of the plant have been studied in detail.

55. Pharmacognostic studies on the leaves of *Eucalyptus globulus* Labill. and allied species found in India.

AMIYA DATTA, Calcutta.

The paper deals with comparative anatomical and pharmacognostic characters of 4 species of *Eucalyptus* leaves, viz., *E. rostrata* Schl., *E. viminalis* Labill. *E. polyanthemes* Scha., and *E. globulus* Labill., grown in India. The official drug is obtained from *E. globulus* Labill. and the other species have been studied with a view to check the adulteration of the dried samples. An analytical key based on anatomical characters of the leaves has also been worked out.

56. Comparative anatomical studies on the leaves of *Hyoscyamus niger* L. and *H. muticus* L.

RAI H. N. CHAUDHURY and AMIYA DATTA, Calcutta.

The crude drug *Hyoscyamus*, according to B. P. is obtained from *H. niger* L. and according to I.P.L. from *H, muticus* L. The alkaloid content in the leaves of the two species are different and the doses of the preparations need adjustment according to the species from which the drug has been prepared. The identification of the crude drugs from dried or powdered samples involves much difficulty as both of them look somewhat similar. In this paper the authors have worked out in detail the anatomical features of the leaves of the two species and have given data regarding vein-islet number, palisade ratio, and stomatal index, which can be considered as diagnostic characters of the drugs.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF ANTHROPOLOGY & ARCHAEOLOGY

Pesident :—Sri TARAK CHANDRA RAY CHOUDHURY, M.A., B.L.

Abstracts

1. Taste Reaction to phenyl-thio-carbamide.

S. S. SARKAR, Calcutta.

153 (113 males, 40 females) Bengalis from the city of Calcutta and 135 (100 males and 35 females) Santals from Santal Pargs. were tested by the taste paper impregnated with phenyl-thio-carbamide, obtained from the American Genetic Association, New York. The percentages of bitter tasters are: Bengali—males—38.05%, females—27.5%; Santal—males—13.0%, females—20.0%. Comparison with other Indian data has been made.

2. Studies of the Whorl in Head Hair of the Oraon.

P. C. BISWAS, Delhi.

In the human being within the hair on the head above the junction of two parieto-occipital sutures one or more whorls occur. The whorls of forty-one Oraons were examined. In this paper a comparative study is made of the occurrence of of whorl of the Oraons with the other people so far investigated. This study reveals that in the appearance of head hair whorl there is a clear indication of racial difference.

3. Relation between Stature and Sitting height of the different hill tribes of South-western extremity of Indian Peninsula.

B. K. CHATTERJEE and G. D. KUMAR, Calcutta.

During the winter of 1949-50, different settlements of the hillmen of Travancore State were visited and data on Sitting height, Stature etc. were collected from among 170 Kannikars, 125 Uralis, 47 Paliyans, 31 Muthuvans, 37 Malapantarams and 19 Kuravans. It has been observed that the length of the lower extremities varies directly with stature and the index i.e. sitting height or torso in terms of the stature taken as 100 varies inversely with the stature. Further it was noted that among the persons having tall stature, the legs are relatively long and the torso relatively short, whereas among the short statured persons it was found to be the reverse. Sitting height index varies with the race, type, stature, age and sex.

4. Proportion of the upper and the lower extremities of the body of the hill tribes of Travancore and Cochin.

B. K. CHATTERJEE and G. D. KUMAR, Calcutta.

The upper and lower extremities of the different hill tribes, viz. 170 Kannikars, 125 Uralis, 37 Malapantarams, 19 Kuravans, 31 Muthuvan and 47 Paliyans were measured in connection with our somatometric studies among them and the results of the comparative mean values of the Brachial and Tibio-radial indices are shown in the table.

	Fore arm (mm.)		Upper arm (mm.)		Lower leg. (mm.)			
	Mean length	Range of Variation	Mean length	Range of Variation	Mean length	Range of Variation	Tibio radial Index	Brachial Index
Kannikar	226.19	315-157	305.35	357-205	371.97	480-307	61.29	75.06
Urali	233.36	289-185	309.98	425-237	379.18	459-273	61.30	75.56
Malapantaram	227.49	333-150	310.81	413-272	381.30	428-254	62.48	75.31
Kuravan	234.05	263-207	314.10	354-298	382.10	420-339	61.56	73.50
Muthuvan	229.48	261-200	315.32	338-286	381.55	413-338	60.02	72.82
Paliyan	230.79	266-202	320-00	414-244	385.85	455-335	59.40	72.55

5. Relation of stature, girth of chest and the weight of body of different hill tribes of Travancore and Cochin state.

B. K. CHATTERJEE and G. D. KUMAR, Calcutta.

The girth of chest, weight and stature of 125 Uralis, 47 Paliyans and 31 Muthuvans were measured and the analysis of the data shows that the relative values are as follows:—

	Stature (mm.)		Chest girth (mm.)		Weight in lbs.		
	Mean value	Range of variation	Mean value	Range of variation	Mean value	Range of variation	Index of Build
Uralis	1544.52	1662-1314	801.78	881-680	99.12	130-70	26.65
Paliyan	1597.43	1706-1452	—	—	100.89	120-70	25.68
Muthuvan	1574.87	1680-1490	820.52	848-745	103.08	118-92	27.70

6. Do the various tribes of India represent only different ethnic types of a race or different races?

B. K. CHATTERJEE, Calcutta.

Detailed analysis of the somatometric characters of the different tribes viz. the Kols of Central Province of India, the Santals of the Santal Parganas, the Kannikars, the Uralis, the Malapantarams, the Kuravans, the Muthuvans and the Paliyans of the Travancore State, was made and the comparison of the respective data with various tribes and castes of India was also attempted to arrive at a conclusion.

7. A Note on Christian Oraons in Sundargarh district, Orissa.

N. PATNAIK, B. RAY BURMAN, and L. MAHAPATRA, Calcutta.

The paper deals briefly with the geo-ethnic environment, migrations, education, language, analysis of village census, marriage social organisation and caste tendencies due to contact with non-Christian neighbours. An attempt has also been made to study the Religion and Economic condition of the Oraons under Christain influence in the Sundargarh district, Orissa.

8. "Mukka—Sendra" (Women's Hunt). Among the Oraons of Chota Nagpur, (Bihar).

BRIND BIHARI VARMA, Delhi.

The Paper is a part of my research work among the Oraons.

It deals with the description and real aspects of the Socio-cultural activities of the Oraon women on such occasion.

Attempt has been made to evaluate the possibility of its origin and recurrence among the tribe.

9. Mahi Valley Microlithic Industry.

BENDAPUDI SUBBA RAO, Baroda.

Mahi valley forms part of the alluvial plain of Gujarat and is the southern limit of the semi-arid loessic plain with dunes formtd during the Pleistocene. This paper describes the Microlithic Culture found on the tops of these dunes. The industry is similar to the one found in the Sabarmati basin in North Gujarat. The types of tools are: Lunate, Triangle Trapeze, Side, End, Oblique and Discoid scrapers, Parallel sided blade, Notched blade of flake and Microburin. Inspite of its typological affinities with the Mesolithic, its age cannot be determined in the present stage of our knowledge.

10. The Microlithic Industry of Tinnevelly.

V. D. KRISHNASWAMI, N. R. BANERJEE and K. V. SUNDARAJAN.

The microlithic artifacts from the 'Teri' sand dune of the S. E. part of the Tinnevelly district of the eighties of the 19th centuries, have been engaging the attention of scholars and workers in Prehistory. But till 1948, when the Dept. of Archeology (South-eastern Circle) intiated a planned exploratory survey, they had neither fully nor comprehensibly been understood. The present paper is the result of such a survey. It may be considered as the first of a series of studies of South Indian Prehistory.

The object of the present paper is, to describe briefly the chief features of this Microlithic industry, as classified and examined of the Departmental collections. The typological analysis showed that there are groups in this industry, a non-geometric and a geometric one; the latter more emphatically in evidence; but unfortunately the stratigraphical relationship of these two groups is largely uncertain owing to the lack of good implement-bearing superpositions in the sites. The tool types include good specimens of lunates, backed blades, triangle, trapezoids, (and 'petit tranchet') well-worked almond shaped points (recalling 'Late Still Bay' points), arrowheads of many varieties including the tanged ones, curved backed points (which recall the Capsian of the West and have a clear counterpart in Ceylon also), auxiliary tool types like awls and scrapers, and well defined group of burinate tools.

11. A note on some folk agricultural rites.

S. R. DAS, Delhi.

Many are the folk agricultural rites observed in different parts of India in order to secure good harvest. In this paper an attempt has been made to refer to some of such rites and thereby to show that agricultural problems, particularly the fertility of the soil and agricultural produces, are solved by the common man by observing some magical rites. In these rites the girls mostly demonstrate the actual growth of paddy and cereals. They sow seeds on earthen-saucers filled with earth and water is sprayed so that earth may be moistened for the germination of sprouts. Rites are observed with these miniature agricultural fields of earthen saucers. They believe that the performance of such rites would ensure bumper agricultural harvest. Here is a clear evidence of the performance of sympathetic magical rites.

12. A note on votive clay figurines used in a folk Rite of Bengal (Illustrated).

S. R. DAS, Delhi.

Clay figurines, human and animal, are commonly used in many folk rites of to-day. In this paper an attempt has been made to refer to some clay figurines used in a folkrite of Bengal. It is highly interesting to note that these clay figurines bear close similarity in form and technique, character and purpose with the terracotta human and animal figurines discovered at Mohenjodaro and Harappa. An interesting reference has been also made to a similar ritualistic practice observed in Taxila from 2nd Century B. C. to 3rd Century A. D. A study of these clay figurines and the associated rituals shows that the basic ideas, form and character are pre-historic and primitive.

13. Culture Contact and Changes in the Rigvedic Society.

K. P. CHATTOPADHYAY, Calcutta.

In this paper the author analyses the data given in Rigveda, Yajurveda, Brahmanas, Srautasutras and Mahabharata to analyse the cultural strata in Rigvedic Society and changes therein. The writer comes to the conclusion that there were three distinct people with different cultures and their interaction built up Rigvedic culture. The difference in material culture and social organisations are indicated as the result of analysis.

14. A Mathematical Analysis of the Phenomena of Human Twins and Higher Plural Births. Part I. Twins.

S. R. DAS, Calcutta.

Four probability functions μ, ϕ, $\mathfrak{D}$ and $\mathfrak{a}$ have been introduced, which represent respectively the probability of monozygotic scission of an (XY) Zygote, the probability of monozygotic scission of an (XX) Zygote, the probability of formation of an additional Zygote after the formation of the first, and the probability of a Zygote being of the (XY) type. The relative frequencies of the ♂♂, ♂♀ and ♀♀ twin pairs have been deduced.

Weinberg's Differential Formula follows naturally from the analysis. The lesser bias of the sex-ratio in favour of the male-sex among twin births is attributed to the fact that μ is less than ϕ.

A rigorous mathematical analysis has been applied and certain probability factors neglected or over-sighted by the previous authors have been introduced.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF CHEMISTRY

President :—R. D. DESAI, M.Sc., D.Sc., F.N.I.,

Abstracts

1. Preparation of Pure Ceria.

G. S. DESHMUKH and K. M. SANKARANARAYANAN, Benares.

A new and rapid method for the purification of commercial samples of ceric oxide is described. This consists in digesting the brown oxide containing about 40% $Ce0_2$ with concentrated nitric acid to a thin paste, diluting with water and precipitating the basic nitrate with ammonium nitrate. This is washed with 5 per cent. ammonium nitrate solution till the precipitate is yellowish white in colour. The precipitate is converted into cerium oxalate by boiling it with concentrated solution of pure ammonium oxalate, filtered, washed free of excess of oxalate, dried and ignited. A yellowish white oxide is obtained indicating the absence of familar contaminants of serium.

2. Complex Compounds of N-Acetyl Thiourea with Mercuric Ion.

S. K. SIDDHANTA and S. N. BANERJEE, Presidency College, Calcutta.

With Mercuric Chloride and Thiourea, three compounds with four, two and one molecules of thiourea respectively per mercuric ion, have been described. (Claus, Ber. **9**, 226, 1876; Rosenheim and Meyer, Zeit. anorg. Chem. **49**, 13, 1906). But with N-acetyl thiourea, attempts to prepare a compound with more than two molecules of thiourea per mercuric ion have failed. Two compounds of thiourea with mercuric iodide, viz. HgI_2, NH_2CSNH_2 and HgI_2, $2NH_2CSNH_2$ have been obtained by Rosenheim and Meyer (loc. cit.). With N-acetyl thiourea however, the only compound HgI_2, $CH_3CONHC\ SNH_2$ of the mono-thiourea type could be obtained even using a higher proportion of N-acetyl thiourea. Thus we see that the tendency for co-ordination of thiourea with mercuric ion, decreases in N-acetyl thiourea. The constitution of the N-acetyl thiourea compounds with mercuric ion have been discussed.

3. On the Stability of Inner-Metallic Complexes.

BASUDEB DAS SARMA and PRIYADA RANJAN RAY, Calcutta.

The paper summarises the results on the investigation of the dissociation or instability constants of a series of bivalent inner-metallic complexes of the third order, the copper and nickel bis-biguanides and dibiguanides. This verifies

Bjerrum's (J. Bjerrum, metalammine formation in aqueous solution, P. Haase and Sons, Copenhagen, 1941), theory of stepwise decomposition of complexes so far as the copper bis-biguanides are concerned for we have obtained not only well-defined step-equilibria in their reaction with acids, but also succeded in isolating a series of copper mono-biguanide complexes (Das Sarma and Ray, J.I.C.S., **26,** 1951, 347), as their first acid-decomposition products. The corresponding nickel bis-biguanides, however, behaved in a different manner and seemed to suffer decomposition in a single step. Alternatively, it may be stated that the mono-biguanides of nickel are not appreciably stronger than their bis-biguanide analogues. The nickel complexes have also been found to be much weaker than the corresponding copper compounds. This has been further confirmed by a number of displacement reactions of copper chloride with nickel bis-biguanides and nickel chloride with copper bis-biguanides. A comparison of the first, second and average acid-dissociation constants of the biguanides with the instability constants of the corresponding copper and nickel complexes, does not, however, show any direct relationship between the basic power of the ligand and the stability of the metal complexes formed by them. The probable factors that influence the complex forming tendency of a metal ion towards a particular ligand in aqueous solution have been discussed.

4. Complex Compounds of Thiodicyandiamidine (Guanyl Thiourea) with Metallic Elements.

SAILENDRANATH PODDAR and PRIYADARANJAN RAY, Calcutta.

Complex compounds of thiodicyandiamidine with bi-and tervalent cobalt, bivalent palladium and bivalent mercury, as well as a salt of the base with disulfito platinous acid have been described and their constitution discussed. Thiodicyandiamidine behaves as a bifunctional group, reacting in its "sulfhydril" form to give inner—metallic complexes, as these decompose into the corresponding metal sulfides on heating with water.

5. Inner-Metallic Complex Salts of Sulphanilamide-Salicylaldehyde and its Derivative.

PRIYADARANJAN RAY and AJIT KUMAR MUKHERJEE, Calcutta.

In a previous paper (Ray and Mukherjee, J. Indian Chem. Soc., **27,** 1950, 77), polycyclic inner-metallic complexes of bivalent copper, nickel, cobalt, manganese, and tervalent iron with salicylaldehyde and different amino-acids like glycine, alanine and anthranilic acid, have been described. In continuation of that we have now succeeded in preparing and studying a number of similar chelate complexes of copper and/or nickel with the condensation product of salicylaldehyde and sulphanilamide or sulphonated salicylaldehyde and sulphanilamide. Both the Schiff's bases, salicylaldehyde-sulphanilamide and the sulphonated-salicylaldehyde-sulphanilamide, behave as bifunctional ligands with their $—SO_2NH_2$ and $—SO_3$ groups remaining free. The reactions were generally carried out in alcoholic solution using copper acetate or nickel acetate. Following compounds were prepared and studied: Copper salicylaldehyde-sulphanilamide Na, Ba, Ca, Sr, Zn, Cd, Ag, Cu, and Pb salts of copper—sulphanilamido-salicylaldehyde sulphonic acid; Na and Ag salts of nickel sulphanilamide-salicylaldehyde sulphonic acid. The silver salt of the copper complex with sulphonated salicylaldehyde-sulphanilamide was obtained in two forms differing in colour—brown and green. They are soluble in aqueous pyridine and possess the same molecular formula. The brown solution of the brown product changes gradually to green, while the green product, curiously enough, forms at first a brown solution which changes finally to green. The absorption spectrum of the two salts in aqueous pyridine, however, gave no difference in visible light. No definite decision between polymorphism or isomerism (cis-trans) can, however, be made at the present stage.

6. Complex compounds of certain Bivalent Metals with Diglycyl-ethylenediamine and Determination of their Instability constants.

PRIYADARANJAN RAY and AMIYA KUMAR CHAKRABURTTY, Calcutta.

Diglycyl ethylenediamine prepared according to the method of Cottrell and Gill (J.C.S., 1947, 129), has been found to behave as a quadridentate molecule giving 4-co-ordinated complexes with bivalent copper and nickel. The complex copper and the complex nickel base of the ligand as well as their chlorides have been prepared and their properties studied.

A quantitative study of the mechanism of formation of the complexes diglycylethylenediamine with bivalent metal ions like Cu^{2+}, Ni^{2+}, Cd^{2+} and Zn^{2+} has been made by the physico-chemical method following Bjerrum, and the instability constants of the corresponding complexes determined. The process consists in the gradual addition of a standard alkali to an acid solution containing a definite amount of the metal chloride and the hydro-chloride of the ligand, and measuring the pH value of the solution after each addition. The values of the instability constants (pK) for the complexes are: Cu, 7.97; Ni, 5.29; Cd, 3.27; and Zn, 3.94.

This shows that as a complexing agent the base is considerably weaker than $\beta - \beta' - \beta''$ – triamino-triethylamine, ethylenediamine and even ammonia, the instability constant values of whose copper complex are given by pK=18.8, 19.6, and 12.6 respectively.

7. Stability of Chromium (III) Biguanide and Chromium (III) Phenylbiguanide Complexes.

DEBABRATA BANDYAPADHAYAY and PRIYADARANJAN RAY, Calcutta.

The stability of Chromium (III) biguanide and Chromium (III) phenylbiguanide complexes have been investigated by studying the decomposition of the complexes by acid, as has been done by previous workers of this laboratory (vide, De, Ghosh and Ray, J.I.C.S., 1950, **27**, 493).

The acid dissociation constants, k_1^* & k_2^*, of the biguanide bases have been determined by measuring the pH of solutions containing known quantities of the base and acid, as described by the previous workers (loc. cit.), and these values have been used in the calculations of the instability constants of the Chromium complexes.

The successive instability constants, k_3 & k_2, have been determined both by graphical method as well as by calculation. But it has not been possible to determine k_1, the instability constant corresponding to the first stage of complex formation.

It has been found that the biguanide complexes are more stable than the corresponding phenylbiguanide complexes as in the Cobaltic series (vide, De, Ghosh and Ray, loc. cit.) and that the Chromium (III) complexes are less stable than the corresponding Cobaltic complexes, and that this is more so for the tris complexes of each of the two biguanides studied here. The difference in stability between the Chromium (III) and the Cobaltic (III) complexes as found here is in keeping with the same for other complexes of these metals.

8. Complex Oxalates of Rhenium. Part II.

DEBABRATA SEN, Calcutta.

In a previous communication, the complex rheni-oxalic acid of formula H_2 $[Re(OH)_4.C_2O_4]$, and its sodium and barium salts were described (Ray and Sen, Proc. Ind. Sci. Cong. Assoc., 1951). In continuation of this work, the following compounds of the general formula R_2 $[Re(OH)_4.C_2O_4]$ have been prepared where R=K, NH_4, Li, Cu(ous), ½ Ca, ½ Ni, ½ Cd, ½ Zn, ½ Pb, ½ $[(CH_2)_6N_4,H_2]$. These compounds are quite stable in the dry state as well as in acid solutions but are readily decomposed by the addition of alkali.

From the nature of the potentiometric titration curve, it has been established that the parent oxalato-acid is really a monobasic one of the constitution H $[Re(OH)_3.C_2O_4.H_2O]$ which in aqueous solution changes partially to the dibasic acid of the formula given above. Sodium, barium and thallium salts of the mono basic acid have been prepared and studied.

9. Iodates and Periodates of Niobium and Tantalum.

DEBABRATA Sen, Calcutta.

Niobium and tantalum are found to give various complex compounds with organic acids such as oxalic, tartaric, salicylic acids, etc. and also with hydroxy organic compounds such as salicylaldehyde, acetylacetone, etc. H_3PO_2 also forms insoluble complex compounds with niobium and tantalum (I. P. Alimarin and T. A. Burova, J. Applied Chem. U.S.S.R., **18**, 289, 1945). In presence of $(NH_4)_2C_2O_4$, only the Ta compound is precipitated whose composition is (Ta_2O_5) $H(PO_2H_2)$. In this paper the preparations and properties of a few complex compounds of Nb and Ta with iodic and periodic acid have been described. T. A. Uspenskaya and Yu. A. Chernikov (Compt. rend. acad. Sci. U.S.S.R., **28**, 800-1, 1940) claim to have separated Nb and Ta by precipitating Ta from its oxalato complex by the addition of iodic acid. The exact composition of the complex was not however given.

10. Formation of Complex Compounds between Potassium Chloride and Alkaline Earth Chlorides.

Part I.—Viscosity.—The System: $KCl—BaCl_2—H_2O$.

L. N. SRIVASTAVA and P. C. BOSE, Lucknow.

Complex compounds between potassium chloride and barium chloride are known to exist in the fused state and also in aqueous solution The compounds: (a) $2KCl.BaCl_2$ (b) $3KCl.BaCl_2$ (c) $KCl.3BaCl_2$ and (d) $KCl.2BaCl_2$ have so far been reported to exist in the fused state. In solution, however, only two of these, viz.:—(a) and (d) have been reported; and no systematic work seems to have been carried out on this problem.

A series of mixed solutions of potassium chloride and barium chloride was prepared in which the concentration of barium chloride was systematically varied from 0 to 0.21 M., while that of potassium chloride was kept constant at 0.05 M. The viscosity of each of the solutions was determined, and the values so obtained were plotted against the concentration of the variant, viz..—barium chloride. The plots indicate eight definite kinks at places corresponding to 6, 12, 16, 24, 36, 48, 72 and 96 C.Cs. respectively of barium chloride solution. Since 24 C.Cs. of potassium chloride are present in each of these solutions, the above points represent the formation of compounds in which the stoichiometric ratios between potassium chloride and barium chloride are as: 4:1, 2:1, 3:2, 1:1, 2:3, 1:2, 1:3 and 1:4 respectively. Thus eight complexes, viz.:—$4KC1.BaC1_2$; $2KC1.BaC1_2$; $2KC1.3BaC1_2$; $KC1.2BaC1_2$; $KC1.3BaC1_2$; $KC1.3BaC1_2$; and $KC1.4BaC1_2$; are shown to exist in aqueous solution. Three of these have been reported to exist either in the fused state or in aqueous solution; while the compounds: $4KC1.BaC1_2$, $KC1.4BaC1_2$, $2KC1.3BaC1_2$, $3KC1.2BaC1_2$ and $KC1.BaC1_2$ have so far not been reported by any one.

11. Formation of Complex Compounds between Potassium Chloride and Alkaline Earth Chlorides.

Part II.—(pH Measurements).—The System: $KC1—BaC1_2—H_20$.

L. N. SRIVASTAVA and P. C. BOSE, Lucknow.

In continuation of the work described in Part—I we report the results obtained by the measurement of pH. On plotting pH values against the concentration of the variant, namely barium chloride, the graph so obtained shows eight definite kinds which correspond to the following compounds: (a) $4KCl.BaCl_2$ (b) $2KCl.BaCl_2$ (c) $3KCl.2BaCl_2$ (d) $KCl.BaCl_2$ (e) $2KCl.3BaCl_2$ (f) $KCl.2BaCl_2$ (g) $KCl.3BaCl_2$ and (h) $KCl.4BaCl_2$.

These correspond exactly to the compounds obtained by the viscosity measurements (Part—I). Other physico-chemical measurements are being made to confirm these results.

12. Formation of Complex Compounds between Alkali Nitrates and Alkaline Earth Nitrates.

Part I.—(Viscosity).—System: $KN0_3—Ba(N0_3)_2—H_20$.

L. N. SRIVASTAVA and K. N. JOHRY, Lucknow.

There is evidence for the formation of two complexes between potassium nitrate and barium nitrate viz., $2KN0_3.Ba(N0_3)_2$ and $2Ba(N0_3)_2.KN0_3$, in the fused state (Wallbridge, Am. Chem. J. 1903, **30**, 154, and J. A. Ricci, Jour. Am. Chem. Soc. 1937. Pt.—II, 1763). The former has been reported to exist in aqueous solution also, by Nayar and Chauhan (Proc. Ind. Sc. Cong. 1949. Pt.—III, 41). A critical examination of the previous work shows that the problem needs further study.

A systematic investigation has now been undertaken to determine the nature and number of compounds that can be formed by the method of "monovariation". A series of mixed solutions of potassium nitrate and barium nitrate were prepared in which the concentration of potassium nitrate was kept constant while that of barium nitrate varied systematically. The viscosity of each of these solutions was determined, and the values so obtained were plotted against the concentration of the varying component viz., barium nitrate. The graph shows five definite kinks. The ratio of the concentrations of the two components at each of these points obeys stoichiometric relation strictly. They are therefore attributed to the formation of compounds corresponding to: (a) $4KN0_3.Ba(N0_3)_2$, (b) $2KN0_3.Ba(N0_3)_2$, (c) $2KN0_3.3Ba(N0_3)_2$, (d) $3KN0_3.2Ba(N0_3)_2$ and (e) $KN0_3.2Ba(N0_3)_2$.

These results are being confirmed by other physico-chemical measurements.

13. Formation of Complex Compounds between Mercuric Chloride and Potassium Chloride.

Part III.—Surface Tension,

M. R. NAYAR and K. V. NAYAR, Lucknow University.

A comparative criticism of the methods of continued variation and of monovariation has been made by reproducing results obtained by both the methods on the same system. The merits of the latter are emphasized.

Measurements of surface tension of a series of mixed solutions of potassium chloride and mercuric chloride have been carried out. The results are in perfect agreement with the previous ones obtained by the study of other widely differing properties like viscosity and refractive index, and indicate the formation of six complex compounds between potassium chloride and mercuric chloride, in solution. The compounds are:

$4KC1.HgC1_2$ $2KC1. HgC1_2$, $3KC1.2HgC1_2$,
$KC1.HgC1_2$ $2KC1.3HgC1_2$, and $KC1.2HgC1_2$.

14. Formation of Complex Compounds between Mercuric Chloride and Potassium Chloride.

Part II.—Refractive Index.

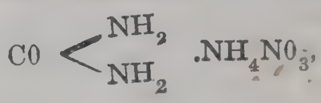
M. R. NAYAR and K. V. NAYAR, Lucknow University.

Evidence, apart from those obtained from viscosity measurements on the system: $HgC1_2—KC1—H_20$ for the formation of six complex compounds ("Proceedings of The Indian Science Congress" 1951), has been obtained from measurements of refractive index, of a series of mixed solutions of potassium chloride and mercuric chloride. The values on being plotted against the concentration of the varying component (Mercuric chloride) gives a curve showing marked deviation from the additivity rule. Six definite minima are obtained at places where the stoichiometric ratios between potassium chloride and mercuric chloride are: 4:1, 2:1, 3:2, 1.1, 2:3 and 1:2 respectively. Thus six complex compounds are found to be produced between potassium chloride and mercuric chloride in aqueous solution. These compounds are: $4KC1.HgC1_2$, $2KC1.HgC1_2$, $3KC1.2HgC1_2$, $KC1.HgC1_2$, $2KC1.3HgC1_2$ and $KC1.2HgC1_2$. These results are in excellent agreement with those obtained from viscosity measurements.

15. Formation of Complex Compounds between Urea and Ammonium Nitrate.

Part I.—(Viscosity and Rheochor).

A. N. BOSE and C. S. PANDE, Lucknow University.

Urea has great tendency for the formation of complex compounds between organic as well as inorganic compounds. Its double compounds with $HN0_3$, $H_2C_20_4$, alkali and alkaline earth compounds are well known. The present paper reports the results obtained with the system: $NH_4N0_3—C0\ (NH_2)_2—H_20$. The method adopted was the same as by Nayar and Pande (Proc. Ind. Acad. Sci., 1948, XXVII, 284). The properties investigated were density, and viscosity and from the latter rheochor values were also calculated. The various values were then plotted against the concentration of urea. The curves obtained indicated one break at concentration corresponding to the compound of molecular formula:  $C0 < {NH_2 \atop NH_2} .NH_4N0_3$, exactly analogous to urea nitrate.

In order to substantiate the above observations, a more quantitative work is in progress.

16. Quinoline Complexes of Cobalt and Nickel Sulphates and their Heats of Formation.

G. C. BHATTACHARRYA and P. C. SINHA, Patna.

Quinoline complexes of Cobalt sulphate and nickel sulphate have been prepared. They have the formula $CoSO_4.C_9H_7N.6H_2O$ and $NiSo_4.C_9H_7N.4H_2O$ respectively. The heats of formation of these compounds have been measured calorimetrically by solution in sulphuric acid. The heats of formation of cobalt and nickel compounds are 3,395 and 11,632 calories/G.F.W. respectively. It seems that the presence of water molecules is necessary for the stabilization of the quinoline complexes of the Bivalent sulphates.

17. Reaction of Nitrates by Alumino-Thermic Reaction.

M. W. NENE and K. K. DOLE, Poona.

In continuation of the work of reduction of sulphates, phosphates and chromates, the study of the reactions of nitrates has been made in this paper. The study of the alkaline earth nitrates has been undertaken. The reactions are followed by chemical analysis, measurement of temperature of the reaction and propagation of flame through the reaction mixture. The nitrates due to their high percentage of oxygen and low heats of formation react vigorously, and temperatures as high as 3100°C. are reached. The analysis indicated no formation of nitride except in one or two reactions. The formation of aluminate is very large and the formation of alumina is very small. The gases evolved are $N0$ and N_2.

18. Constituents of Colloidal Arsenic Sulphide.

A. K. M. TRIVEDI and M. J. PATANI, Ahmedabad.

Concentrated aged arsenic sulphide sols are prepared by passing hydrogen sulphide gas for a long time in a concentrated solution of arsenious oxide and then evaporating the sol obtained, on water-bath. The nature and the amount of the stabilizing ion per gm. of the colloid have been investigated. Composition of the particles of the sol has been determined by two different methods.

19. Hydration of Colloidal Arsenic Sulphide.

A. K. M. TRIVEDI and M. J. PATANI.

Hydration in the case of arsenic sulphide sols has been investigated by studying the distribution of a reference substance between the coagulum and the supernatant liquid. It has been found that when the sol is coagulated by low concentration of sodium chloride, the coagulum is hydrated but most of the stabilizing ion comes out in the supernatant liquid. The coagulum in this case was found to be irreversible It has been concluded that in order to have the coagulum reversible, it should remain hydrated as well as the stabilizing ion should be retained by the coagulum.

20. Role of Electrode Assymmetry and Partial Irradiation in the Production of Joshi Effect, $\triangle$ i in Nitrogen.

M. V. RAMANAMURTI and G. R. SOMAYAJULU, Banaras.

Studies for Δ i in nitrogen were made in various types of discharge tubes of widely different electrode areas. Siemens' ozonizers (with maximum assymmetry) and tubes with two spherical bulbs of sensibly identical radii (minimum assymmetry). The **effect** Δ i was 100% current diminution in the former over widely varied operative conditions while the latter showed a maximum of 25%. This indicated that large electrode assymmetry favours Δ i. Irradiation of the entire tube or the high tension electrode alone (in the latter) showed $-\Delta$ i; the low tension (or earthed) electrode, however, was associated with both + and $-\Delta$ i depending upon operative voltage. Essentially similar results were obtained in **tubes** with metallic electrodes. It follows, therefore, that the dielectric nature of the electrode is not an essential condition for the formation of 'electrode layer' postulated by Joshi, primary for Δ i.

21. Preferential Incidence of Joshi Effect in the Ohmic Part of Ozonizer Current in Nitrogen under Silent Discharge.

M. V. RAMANAMURTI and G. R. SOMAYAJULU, Banaras.

Joshi emphasized the necessity of the onset of dielectric break-down under applied fields (at the threshold potential, V_m) for Joshi Effect, $-\Delta$ i. Ossillographic studies of Marathe and Ramachandran (Part III, Phy. Sec., A. 21, p. 22, 1951) revealed the capacitative nature of pre-V_m current. Measurements of current i and of Joshi Effect. Δi are now made in the pre-V_m region (and also above V_m) in Siemens' ozonizers filled with nitrogen at its optimum pressure viz., 20 mm. Hg. and excited by 50 ∽ potentials V(0—2 kV). The voltage drop across a serially included inductance L (2500 μ henries) or a non-inductive non-capacitive resistance R(0.015—1.0 M Ω), determined by a diode (83 V RCA) and a galvanometer, indicated the ozonizer current i. Pre-V_m current was considerably small compared to i due to V V_m. Δ i increased linearly with V upto V_m; and exponentially thereafter. Extrapolations of the initial linear increase and the later steep rise of i, meet at V_m. V_m (e.g., 610 ± 5 volts) was independent of L and R.

No $-\Delta i$ in the pre-V_m current could be observed even under intense and short wave radiations; appreciable $-\Delta i$, however, was obtained at $V > V_m$.

Extension of linear increase of pre-V_m current aided isolation of capacitative component of i at $V > V_m$; and hence the ohmic part, i ohmic was known. % Δi total was recalculated as proportionate decrease (% Δi ohmic) of the i ohmic; i capacitative being nil. Both % Δi total and % Δi ohmic) are maximum at V_m and decreased thereafter, for a fixed L or R. With increased R, % Δi total, diminished rapidly (at a constant V) while % Δi ohmic was constant; e.g., $-\% \Delta i$ ohmic $= 100$ at V_m for all values of L and R indicating $-\Delta i$ linked preferentially with the i ohmic. These findings were fully warranted by simultaneous oscillographic studies and are accounted for in the light of Prof. Joshi's theory for $-\Delta i$.

22. Production of Joshi-Effect in Nitrogen under Sleeve-Excitation: Influence of Gas Pressure and Volume.

M. V. RAMANAMURTI and S. C. PADHI, Banaras.

Marked dependence of **Joshi Effect,** Δi in nitrogen on the inter sleeve distance (d) and applied potential (V) was already reported (Murti and Prabhakaram, Part III, Chem. Sec., A. 22, p. 40, 1931). Present paper deals with the influence on Δi of pressure, p and volume of N_2 enclosed between the sleeves at constant d = 15 mms. p = 5—50 mm. Hg. and tube diameters (D = 1—20 mm. were studied. Joshi Effect was + ve at low V, decreased to zero at a critical inversion potential V_c and was — ve at $V < V_c$; large V inhibited $-\Delta i$. anticipating a second inversion to $+\Delta i$ at larger V. Potential range favouring $+\Delta i$ increased with p; while that for $-\Delta i$, decreased. Maximum $-\Delta i$, viz., 95—98% current diminution occurred at $^{p}N_2 = 20$ mm. Hg. Both $\pm\Delta i$ were maximum with smallest D viz., 1 mm. and decreased with increased D.

V_m increased linearly with p analogous to V_s, spark potential; it was maximum (at a constant p) for D = 1 mm., decreased upto D = 4 mm. and remained steady thereafter.

23. Influence of 'Ageing' on Joshi Effect in Nitrogen.

M. V. RAMANAMURTI and S. C. PADHI, Banaras.

Role of 'ageing' viz., continued exposure to discharge due to constant applied potential, in the inception and growth of Δi has been emphasized by Joshi. This factor is now investigated in Siemens' ozonizers (pre-degassed by constant evacuation while subjecting to discharge under high applied fields) filled with nitrogen (p = 20 mm. Hg). **Freshly** filled ozonizers showed no Δi initially; Δi was developed **after** 15—20 mms. of 'ageing' and increased progressively to a maximum (e.g., 95—98% current diminution at V_m). Prolonged 'ageing', however, decreased $-\Delta i$ partially.

The progressive growth of $-\Delta i$ during 'ageing' is attributed to the discharge favouring an otherwise slow or practically no formation of the 'electrode layer' contemplated by Joshi as primary for Δi. It is suggested that this 'layer' constitutes of (gas) molecules oriented on the 'electrode surface' probably as 'electrical dipoles', possessing characteristic light absorption and low dissociation energy as distinct from those in the gas bulk. Such discrimination was also necessitated since the entire $\Delta\ i$ could be obtained by irradiating simply the electrodes (by wave-lengths in and outside the selective absorption of the excited medium); its frequencywise variation; and also its non-occurrence when the gap alone was illuminated keeping the electrodes screened especially in external sleeve and Geissler tube discharges.

24. Influence of 'terminal reversal' on the magnitude of the positive and negative Joshi Effect.

K. S. VISVANATHAN and E. W. GODBOLE, Banaras.

While the magnitude of the **Joshi Effect** is markedly influenced by 'terminal reversal' the nature of the influence differs with the sign of the Effect. During the present investigations on the influence of terminal reversal on the production of the Joshi Effect in ammonia and ($N_2 + 3H_2$) mixtures excited in Siemens' ozonizer, it is observed that the influence of terminal reversal is generally to increase numerically $-\%\ \Delta\ i$ but to decrease $+\%\ \Delta\ i$. Thus, in NH_3 at 50 mm., at 1.15 kV, with 'normal' connections i.e., with the inner electrode connected to H.T. and the outer electrode earthed, the value of $-\%\ \Delta\ i$ is 23.8 which increases to 46.7 on reversing the terminals. On the other hand, at 100 mm, at 2.21 kV, the value of $+\ \%\ \Delta\ i$ for 'normal' connections is 19.1 and it decreases to 14.3 on terminal reversal. The current detector employed was a Cambridge, oxide double wave rectifier type microammeter.

Based on Joshi's finding (ref. Nature, 1947, 16, 19) that $-\%\ \Delta\ i$ is brought about by the preferential suppression of the H.F. components of the discharge current, an increase in the magnitude of $-\%\ \Delta\ i$ on terminal reversal leads to the anticipation of an increase in the number and amplitude of the H.F. pulses on terminal reversal. This expectation has been verified oscillographically.

25. On the influence of 'terminal reversal' on the threshold potential V_m.

K. S. VISVANATHAN and E. W. GODBOLE, Banaras.

The fundamental importance of the threshold potential in the production of the **Joshi Effect** and its dependence on the nature of the surface, which is an important determinant in the theoretical mechanism developed by Joshi, is once again brought out by the present investigations on the influence of terminal reversal on the threshold potential in ammonia as well as in ($N_2 + 3H_2$) mixtures excited in a Siemens' ozonizer. At all the pressures of the above gases studied, a change, i.e., a decrease in V_m on 'terminal reversal' is observed. Reference may be made to the investigations of Huxley[1], Watson[2], Townsend[3], Bruce[4], Boulind[5], Loeb[6] and others on the striking potentials of the positive and negative wire corona discharges. They have attributed the observed disparity of the values of the striking potentials to the influence of adsorbed gas films. Trichel[7] has shown that it depends on the work function of the surface for secondary emission, as also, on the accumulation of space charges. These observations therefore necessarily support the views maintained all along by Joshi[8] as to the mechanism of the Effect.

1. Huxley—Phil. Mag., 1930, 10, 185.

2. Watson—'The Electrician', 1940.
3. Townsend—Phil. Mag., 1934, 18, 594.
4. Bruce—Ibid., 1930, 10, 475.
5. Boulind—Ibid., 1934, 8, 909.
6. Loeb—'Fundamental Processes ——'.
7. Trichel—Phys. Rev., 1938, 54, 1078.
8. Joshi—Curr. Sci., 1947, 16, 19.

26. Studies of Joshi Effect in I_2 Vapour under H. F. Excitation

N. SUBRAHMANYAM, G. M. APPARAO and J. V. SARMA, Banaras.

Discharge tubes containing Iodine vapour in equilibrium with solid iodine were excited (using outer sleeve electrodes) in the frequency range 1 —10 Mc., obtained by Hartley oscillator and the influence of inter sleeve separation d (10 — 60 mm), tube diameter (7 — 40 mm) and intensity of irradiation 41 —346 (the relative values of the intensities of a 200 watt bulb run at voltages 60 — 220) were investigated.

With increasing sleeve separation d the conductivity in dark decreased at constant V, Δi and % Δi were found to be maximum when d = 20 mm. Thus e.g., at d = 10 mm., iD, Δi and % Δi were 460, 0, 0; at d = 20 mm. they were 222, 48 and 21.6 and at d = 60 mm they were 70, 0, 0 respectively at V = 35.1 R.F. and F = 3.0 Mc.

With increasing intensity of irradiation Δi and % Δi increased uniformly and attained saturation at higher intensities. The range of potentials over which Joshi Effect occurred was large in the case of tubes of large diameter. Thus e.g., at D = 7 mm. the range favourable for Δi was 12 to 17.5 volts and at D = 42 mm. it was from 11.1 to 27.3 volts. Further at D = 7 mm. and 42 mm., % Δi was 18 and 35.8 at V = 17.5 R.F., and F = 8.025 Mc. The above results were in accordance with the existence of electrostatic and electro-magnetic fields in H.F. discharges and the inhibitive influence of the latter for Δi.

27. Behaviour of H_2 (1 — 40 mm.) under Tesla excitation.

N. SUBRAHMANYAM, J. V. SARMA and G. M. APPARAO, Banaras.

Detailed studies if **Joshi Effect** Δi in hydrogen under low frequency excitation have been undertaken by previous workers and the present work was an extension of the same to damped high frequency input fields obtained from the secondary of a Tesla coil. In cylindrical discharge tubes fitted with external sleeves, the discharge was bright and only + Δi was observed in the pressure range studied 1—5 mm. The effect was maximum at the striking potential and the magnitude decreased with V. Thus e.g. at 0.34 kV the + % Δi was 22.73 and at 0.61 kV it was 1.7 and no Δi could be detected with further rist in V. Ageing under discharge did not seem to have much influence on the magnitude of Δi, but the range of potentials over which + Δi occurred decreased with aging. Thus initially the range was 0.34 — 0.61 kV while after 4 hours aging it decreased to 0.34 — 0.48 kV. In the range studied (1 — 5 mm.) the magnitude of Δi increased with pressure. Thus e.g. at 1.5 mm. (.34 kV) and d = 30 mm. + % Δi was 22.73 and at 4 mm it was 41.2.

In the case of ozonizers (5 — 40 mm) fitted with external sleeves a large

$+ \% \Delta i$ was observed over a wide range of potentials, which changed sign by earthing the central electrode. Thus initially at 0.41 kV the $+ \% \Delta i$ was 246.1 and it was —33.3 in the latter case. Earthing the central electrode reduced the current values in dark. Here also the sign and magnitude of Δi depend to a great extent on the relative influence of electrostatic and electromagnetic fields which simultaneously exist with external sleeve H. F. excitation, the predominance of one or the other depends on the intensity of exciting field, the type of the discharge tube and pressure.

28. Studies of Joshi Effect in Carbon monoxide.

S. M. DESHPANDE, Banaras.

Studies of the **Joshi Effect** in carbon monoxide in ahe pressure range 4—639 mm. Hg. were made in an all glass Siemens' ozoniser subjected to an A.C. discharge of 50 cycle frequency. The magnitude of the negative effect increased with increase in pressure to a maximum of 96—98% at 24-35 mm. Hg. and decreased there after. $- \% \Delta i$ for any pressure was maximum near about V_m and decreased with increase in applied potential.

The effect of 'Ageing' studied at 30 mm. Hg. and under a constant potential of 1.47 kV, was to diminish the effect, $-\% \Delta i$, from 78.1 to zero after 3½ hours. The current iD and iL increased during the period of 'aging' and became equal after 3½ hours. The effect, $-\Delta i$, was not restored when fresh gas at various pressures was introduced in the non-cleaned ozonised and in the same after cleaning with chromic acid solution. This non-occurrence of the effect after a particular period of 'aging' is probably due to the permanent 'poisoning' of the walls of the ozoniser which is the result of the formation of non-removable carbon sub-oxide deposit.

29. Study of Joshi Effect in Benzene in different discharge tubes: Part I. Influence of applied potential.

S. M. DESHPANDE and R. A. SHARMA, Banaras.

Studies of **Joshi Effect,** Δi, in Benzene, subjected to A.C. discharge of 50 cycle frequency, were made in (i) Quartz ozoniser, (ii) Siemens' all glass ozoniser, (iii) Semi-ozoniser with central platinum wire, (iv) Geissler tube having aluminium electrodes, (v) sleeve tubes and (vi) ozoniser coated internally with KCl.

At 13.0 mm. Hg. pressure a maximum negative effect of the order of 50.8% at 2.53 kV (V_m) which decreased with increase in kV, was observed in kV, in Quartz ozoniser irradiated by ultra violet light. In all glass ozoniser on irradiation by light from a 500 watt bulb a large $+ \Delta i$ alone was noticed above 30.2 mm. Hg. pressure, at 13.8 mm. Hg., however, both a large $+ \Delta i$ at low potentials and $- \Delta i$ of the order of 41.7% (at 0.93 kV) which increased with increase in kV to about 59.0%, were obtained. In semi-ozoniser at 26.5 mm. Hg. pressure a large positive effect below 1.87 kV and negative effect showing a maximum of 14% at 2.4 kV were noticed. Geissler tube when irradiated by light from mercury vapour lamp showed negative effect to an extent of 75% (at 2.6 kV) which decreased numerically with the increase in kV, the pressure of C_6H_6 being 16.2 mm. Hg. In the case of sleeve excitation at 26.54 mm. Hg. pressure, no effect was observed when two and four sleeves were used; with six and eight sleeves, however, a large $+ \Delta i$ (10,000%) and an appreciable $-\Delta i$ (17%) were noticed.

The magnitude of $-\Delta i$ showed a decreased with increase in applied potential. In KC1 coated ozoniser under the conditions studied, positive effect alone was observed.

30. Study of Joshi Effect in Benzene: Part II. Influence of 'aging', A.C. supply frequency and Intensity and Frequency of light.

S. M. DESHPANDE and R. A. SHARMA, Banaras.

In extension of the earlier studies on **Joshi Effect** in benzene reported in Part I of these Abstracts, the influence of the above four parameters has been investigated.

The influence of 'ageing' as studied in Quartz-ozoniser, at a pressure of 74.6 mm. Hg. was to diminish the negative effect, $-\Delta$ from 28% to 19% and increase the discharge current iD.

With change in A.C. supply frequency from 50 to 500 cycle per second as studied in glass ozoniser, it was found that negative effect decreased numerically from 37% at 50 cycle to 29.8% at 500 cycle per second. Positive effect observed at lower potentials was, however, not much affected.

The diminution in the negative effect, $-\% \Delta i$, with decrease in the intensity of irradiation as observed in $C_6 H_6$ in quartz ozoniser is fully in agreement with the earlier results obtained in other systems.

That the variation in the negative effect, $-\Delta i$, is frequency-wise viz., white > violet > green > red, has also been proved by the results in $C_6 H_6$.

31. Study of Joshi Effect in Benzene: Part III. Influence of Pressure and Temperature.

S. M. DESHPANDE and R. A. SHARMA, Banaras.

With increase in the pressure of the system in Quartz ozoniser subjected to an A.C. discharge of 50 cycle frequency the effect, $-\Delta i$, was found to diminish numerically viz., from 50.8% at 13.2 mm. Hg. to 41.5% at 26.5 mm. Hg. At higher pressure viz., 74.7 and 182 mm. Hg. a large $+\Delta i$ at lower potentials and $-\Delta i$ to the extent of 18 and 20% at higher potentials at the respective two pressures, were obtained. In glass ozoniser on irradiation by light from a 500 watt bulb and at and above a pressue of 30.2 mm. Hg. positive effect alone was noticed which decreased numerically with increase in pressure viz., from 650% at 30.2 mm. Hg. to 0% at 30.4 mm. Hg. At 13.8 mm. Hg., however, both a large $+\Delta i$ (233%) at 0.87 kV and $-\Delta i$ at and above 0.93 kV were observed, the value of $-\% \Delta i$ at 0.93 kV being 41.7.

Consistent with the general findings of Joshi and co-workers on the influence of temperature on Joshi effect in elementary gases, the negative effect, $-\Delta i$, was found to diminish numerically at higher temperatures viz., from 47.1% at 33°C to 39% at 55°C, when studied at a pressure of 26.54 mm. Hg. in glass ozoniser (supply frequency 50 cycle per second). This is probably due to the deconditioning of the 'boundary layer' at high temperature.

32. Comparative Studies of Joshi Effect in H_20 and H_2S.

N. A. RAMAIAH and K. PARVATI DEVI, Banaras.

Earlier results (Proc. Ind. Sci. Cong., Phy. Sec. 1950) have shown marked similarity in the behaviour of Δi in H_20 and D_20, which was attributed to the identical extra-nuclear electronic configuration of the isotopic molecules. Electronic configurations of H_20 and H_2S are similar. Comparative studies of Δi were therefore, made in Siemens' type ozonisers filled separately with H_20 and H_2S over a range of pressure $p = 1 - 55$ mm. Hg. and potential $V = 0.5 - 3$kV(50∽). As. in H_20, Δi in H_2S could but be detected at $p > 2.5$ mm.; increased to a maximum and then decreased with rise of p. Thus e.g. at threshold potential V_m, —% Δi was 52.2, 26.8 and 3.8 at $pH_2S = 6.7$, 17 and 36.4 mm. Hg.; it was 41.6, 36.2 and 3.8 at $pH_20 = 8.6$, 12.8 and 33 mm. Hg., respectively. Maximum effect of 64.3 current diminution was obtained at optimum p of 3.1 mm. Hg. of H_2S.

Decomposition of H_2S under electric discharge leading to deposition of sulphur on the electrode area and the corresponding change in Δi were studied.

33. Influence of Wall-coatings on Joshi Effect in Water Vapour.

N. A. RAMAIAH and P. V. RATNAM, Banaras.

Variation of Δi with the nature of wall-surface was studied in Siemens' type ozonisers. These were acid-treated and then coated with KC1 (b), $A1_20_3$ (c), $HP0_3$ (d); the other was blank (a). They were filled with H_20 at 15 mm. Hg. and excited by 50 ∽ potentials; the current i was measured by a diode. Amount of ageing necessary for initiation of Δi was little in (b) and appreciable in (a) and (c). Magnitude of Δi was in the order: KCl > blank > $A1_20_3$. Thus e.g. at 0.66 kV, % Δi was 82.6 (*b*), 46.9 (*a*), 11.4 (*c*). Δi could not be detected in (*d*).

Theoretical significance of these results in light of the findings due to Taylor and Lavin (Jour. Amer. Chem. Soc. **52,** 1910, 1930) and Badin (ibid. **70,** 3651, 1948) was discussed.

34. Influence of temperature and pressure on irreversible Joshi-Effect in nitrogen in the hysteresis range below the threshold potential.

K. S. VISWANATHAN, A. K. HOTA and G. PATRA, Banaras.

Irreversible **Joshi-Effect** had been observed and reported in (N_2 + 3 H_2) mixtures (cf., Viswanathan ef al, Proc. Ind. Sci. Cong. 1950. Part III p. 26) and in chlorine (cf. Marathe and Bommannawar, Nature, 1950, **165** 890). The phenomenon has now been extended to pure N_2 which, when exicted in a siemens' ozoniser by A.C. potentials of 100 cycles frequency shows the irreversible Joshi-Effect in the pressure range 20 — 70 mm. The effect is obtained only below V_m and is confined to the hysteresis loop of the current-potential characteristic. Temperature is found to exert a marked influence both on the range as well as the upper limit of the pressure of the gas and the applied potential at which the irreversible effect is observed. Lowering the temperature of the system is found to extend the range of pressure over which Joshi-Effect remains irreversible. This is true of the applied potential as well. Raising the temperature tends to shorten the pressure and potential ranges of irreversible effect; at sufficiently high temperatures, the irreversible effect is even destroyed. Thus the irreversible Joshi-Effect is not given by the gas at 90 mm. at room temperature but is developed by the system when the temperature is lowered to 10°C. At high enough temperatures, the system gives the positive Joshi-Effect below V_m which unlike the negative effect, shows no irreversibility, while the irreversible negative effect is observed always with the fresh gas, 'ageing' is found to destroy it.

35. Production of Joshi Effect in a Topler Evacuated Ozoniser in presence of Mercuric Iodide.

B. M. SHUKLA, K. N. KHARE and A. UPADHYAYA, Banaras.

In view of the significant results obtained by using suitable substances for the production of $\Delta\ i$ (Proc. Ind. Sci. Cong., Chem. Sec. Abst., 26, 1951), the role of HgI_2 as an electrode surface contaminating material has been studied. The ozoniser, with an attached bulb containing HgI_2 powder and evacuated under topler. was excited in the range 0.4 kV to 2.6 kV by an alternating field of 50 cyc. frequency. Observations were first made before the electrode surface was contaminated with HgI_2 powder. A measurable current initiated at 0.4 kV and increasing subsequently with increase in kV, showed no $\Delta\ i$. Prolonged 'ageing' was unhelpful in producing any $\Delta\ i$.

However, on bringing the HgI_2 power in contact with the electrode walls by continuous shaking and again removing the whole by tapping, a —91.2 % $\Delta\ i$ at 0.57 kV is markedly observed. i_D also shows an increased value. A prolonged 'ageing' now does not alter the effect substantially.

The marked production of $\Delta\ i$, due to mere surface contamination by HgI_2 powder is important for theoretical consideration and is in accord with previous results.

36. An Electron Diffraction Study of Epitaxial Crystal Growth in Electrodeposits and the Relief of Epitarial stress by Rotational Slip.

A. GOSWAMI, Calcutta.

An electron diffraction study of epitaxial growth of Cd an Cu (110) face and the relief of stress in the deposite-substrate interfacial region has been made. Cd assumes a two degree orientation on copper with $\{10\bar{1}3\}$ planes parallel to $\{110\}$ of copper and the [1000] of Cd along $[1\bar{1}0]$ axis of copper. Evidence of relief of epitaxial stress due to misfits of atoms in the deposit-substrate region by rotational slip on $\{11\bar{2}0\}$ planes, has been produced. Similar case of rotational slip has also been observed in the case of epitaxially grown Cu_20 on (110) face of Cu.

37. Measurement of ion activity by means of resin membrane electrodes.

S. K. SINHA and S. K. MUKHERJEE, Calcutta.

Membrane electrodes prepared from synthetic exchange resins dispersed in a suitable binder resin, usually polystyrene or methyl methacrylate, were found to register ion activities in electrolytic solutions placed in contact with them. The e.m.f.'s between two calomel electrodes placed in solutions having known ion activities on both sides of the membrane when compared with the theoretical values give a measure of the performance of the membrane electrodes. The electrodes are generally found to be satisfactory within particular ranges of ion activities. For instance, membranes prepared from Amberlite IR—100 do well within the range of $^{a}\mathrm{Na}$ = .2367 to .00292, whereas those obtained from IONAC C-200 are efficient over a wider range, and also up to a higher concentration of Na^{+} ions (1.0 m. to .001 m.). Equilibrium with ions is attained much quicker in the case of C-200 membranes than those of the Amberlites.

Membranes made from Amberlite IR-4B, an anion exchanger, are found to be reversible with respect to Cl^{-} ions in solutions of NaCl and to measure the Cl^{-} ion activity fairly accurately within the range $^{a}\mathrm{Cl}$ = .2367 to .00097. No previous attempts are known to have been made to measure Cl^{-} ion activity by means of the resin membrane electrodes. Experiments with other anions are in progress.

38. Measurement of cation activity by the use of clay membrane electrodes.

D. K. MITRA and S. K. MUKHERJEE, Calcutta.

Clay membrane electrodes were prepared by evaporating into thin films aqueous suspensions of less than 0.5 micron subfraction of the clays of a Kashmir bentonite, a Tinpahari bentonite, and a Padegaon B type of black cotton soil. The membranes were preheated to desired temperatures and their performances examined by making measurements with solutions of electrolytes having known cation activities. The membranes prepared from Tinpahari bentonite and heated to 400°C and 500°C are fairly satisfactory so far as electrical conductance and Na^{+} ion activity measurements are concerned but, although otherwise stout, are liable to crack as a result of slight swelling. This occurs irrespective of the heating temperature. The membranes prepared from the Kashmir bentonite and the Padegaon clay are, unlike the Tinpahari bentonite, mechanically stout and do not swell at all. 400°C Kashmir bentonite membranes measure satisfactorily Na^{+} ion activity within the range, $^{a}\mathrm{Na}$=.00097 to .2367. The higher limit for these membranes is definitely higher than that observed by previous investigators. The 500°C Kashmir bentonite membranes register Na^{+} ion activity but no Ca^{++} ion activity at all; however, it takes longer time to attain equilibrium than the 400°C membranes. It is likely that the 500°C membranes will be selective towards Na^{+} or other monovalent cations, in presence of Ca^{++} or other bivalent cations. By far the best so far as attainment of equilibrium and electrical conductance are concerned, are the 500°C Padegaon clay membranes. They do well over the same range as the Kashmir bentonite membranes; both, however, show a lower potential compared to the theoretical at still higher activities. The asymmetry potential, which is usually not very high, decreases slowly in the case of the other two types of membranes but the Padegaon clay membranes appear to possess none at all.

39. Concentration and Viscosity of Dilute Solutions.

ASOKE KUMAR MUKHERJEE, Jadavpur, Calcutta.

Arrheniu's equation $\eta_{\gamma} = B^{c}$, where, η_{γ} is the relative viscosity of the solution, 'c', the concentration of the solute and B is a constant has been derived from theoretical considerations. The assumption involved is that the fludity of a liquid is a function of its free volume. Starting from this, fludity and free energy of a liquid has been connected through the partition function of liquid molecule and then the relationship between viscosity and concentration has been deduced from a purely thermodynamic consideration. The limitations of the equation have been pointed out, the most important of which is that the equation should be valid for dilute solutions only.

40. On the Origin of the Third Ionospheric Echo.

R. B. BANERJI.

There is still some difference of opinion regarding the ray—ordinary or extraordinary—to which the so-called third or Z-component of the ionospheric echoes correspond. It is pointed out in the paper that there need be no controversy on the subject because, as first clearly shown by Bhar, the branch of the dispersion curve which passes through the 'point' of reflection of the Z-component is really an ordinary branch. Calculations are further carried out to determine the retardation that the extraordinary ray would suffer, if it were able to partially penetrate its first point of reflection, in its passage into regions of higher electronic densities. It is found that the retardation on reaching the asymptote of the dispersion curve would become infinite, so that, the extraordinary ray, under no circumstances, is able to penetrate the barrier. One is thus forced to the alternative that it is the ordinary ray which provides the Z-component in the ionospheric echo pattern.

41. Studies on Ion-Exchange and Electro-kinetic Properties of Synthetic Cation Exchangers.

PARITOSH DE and MIHIR SEN GUPTA, Calcutta.

The effect of electrolytes containing ions of varying valencies on the electrical charge of cationic resins has been investigated. It has been observed that resins (H^+ and Na^+ Amberlite) in contact with water and solutions of different electrolyte, are negatively charged. With increasing concentration of the electrolytes the negative charge increases and no reversal of charge occurs even in presence of salts containing polyvalent cations like Al^{+++} and Th^{++++}. This is rather remarkable in view of the fact that the negative charge of most colloidal systems is reversed by such polyvalent counter ions, specially when their concentration is relatively high.

The adsorption of the cations of the added electrolytes from the solution by the resins has also been measured. It has been found that the extent of adsorption follows the order $Ag^+ > K^+ > Na^+$ and $Ba^{++} > Ca^{++}$.

42. Effect of the quantity of the chromatographed amino-acids and sugars on their R*f* values and the areas occupied by them on the chromatogram in paper chromatography.

D. P. BURMA, Calcutta.

The R*f* values of the amino-acids and sugars, subjected to paper chromatography remain fairly constant over a wide range of concentration (5 mg./ml. —

150 mg./ml.). This, perhaps is one of the strongest evidences in favour of 'partition' mechanism for paper chromatography. The areas occupied by the spots on the chromatogram vary linearly with the logarithm of the contents of the amino-acid or sugar over a limited range only. The R_f values and the areas occupied by the spots are considerably affected by the presence of others, the extent of variation depending on the concentration of the latter.

43. Broken Bonds in Quartz.

A. K. GANGULY (Calcutta) and B. CHATTERJEE (Sibpur).

In continuation of our studies on the existence of 'broken bonds', as the seat of ion exchange, in aluminosilicate minerals and in their constituents, the exchange behaviour of quartz in acetone and benzene media using hydrochloric and acetic acids has been discussed. Quartz has been found to adsorb quite an appreciable amount of hydrochloric acid (and/or chloride) and acetic acid (and/or acetate) from non-aqueous medium. The amounts of these acids adsorbed from benzene and acetone have been observed to be almost identical to the base exchange capacity of quartz pointing to an equal adsorption of cations and anions. The observed amphoteric character of quartz may be taken to prove the presence of 'broken bonds' in this system. The 'broken bond' concept has been found to explain satisfactorily the ion exchange behaviour of quartz and other aluminosilicates.

44. Studies on Surface Area and Catalytic Activity of some Oxidation Catalysts.

N. VENKATARAMAN and S. K. BHATTACHARYYA, Bangalore.

Surface area often provides a valuable tool in determining the extent of catalytic activity and also in elucidating the mechanism of catalytic reactions.

Surface areas of a large number a vanadium catalysts which were developed in this laboratory for the oxidation of benzene to maleic acid and reported earlier (Proc. 38th Ind. Sci. Cong., Part III, Abstracts) were determined by the well known B. E. T. Technique, with a view to find out any possible relationship between the activity of these catalysts and their surface areas. The results may be summarised as follows:—(i) the surface area of the vanadium oxide—kieselguhr catalyst decreased greatly with the addition of promoters like molybdenum oxide or molybdenum and cobalt oxides but contrary to expectation, the activity was found to increase considerably with the addition of the promoters; (ii) catalysts prepared by using Indian kieselguhr having a surface area of 29.75 m^2/g as the support were found to be much more active than those supported on B. D. H. Kieselguhr (surface area $= 1.44 m^2/g$), pumice (surface area $= 0.8 - 1.0,\ m^2/gm$) etc.; (iii) the catalyst prepared by the thermal decomposition of oxalates was found to have greater surface area and greater activity than the one prepared by the decomposition of ammonium salts. These results clearly indicate that in respect of (ii) and (iii) some relationship between activity and surface area does exist, whereas, in respect of (i) the catalytic activity cannot be accounted for on the basis of surface area but may be explained assuming that promoter increase the number of active centres resulting in enhanced activity.

45. Magnetism and Catalysis. Part I. Magnetic Study of Vanadium Catalysts.

V. RAMAKRISHNA and S. K. BHATTACHARYYA, Bangalore.

Magnetic susceptibilities (M.S.) of a number of vanadium catalysts developed in this laboratory for the oxidation of benzene and croton aldehyde to maleic acid were determined by the well known Gouy's method, with a view to find out any possible relationship between the activity of these catalysts and their susceptibilities. The influence of various factors, e.g., method of preparation of the catalyst, catalyst support, promoter, concentration of the catalyst, etc., was studied. All the samples were found to be paramagnetic. The M.S. of purified Indian Kieselguhr was found to be very much less than the purified B.D.H. variety. The M.S. unsupported V_20_5 catalyst was found to be much less than the V_20_5 —Kieselguhr catalyst. The catalysts prepared by the decomposition of the oxalates gave higher values of M.S. than those prepared by the decomposition of the ammonium salts. The addition of promoters like molybdenum oxide or oxides of molybdenum and cobalt to the vanadium oxide — Kieselguhr catalyst—did not give M.S. values of sufficient significance. The M.S. values of tin vanadates prepared by four different methods were determined. Attempts are being made to correlate these M.S. data with the activity of the catalysts studied.

46. Studies on the Iodination of Ricinoleic Acid in the Dark in different non-polar Solvents.

P. K. BHANDARI and S. K. BHATTACHARYYA, Bangalore.

The kinetics of the addition of iodine to ricinoleic acid in the dark was studied at various temperatures in non-polar solvents like carbon tetrachloride, benzene and dioxane. The reaction was found to be a reversible one and termolecular with respect to iodine and unimolecular with respect to the acceptor. The rate of reaction was found to depend to a great extent upon the nature of solvent.

The temperature co-efficient of the reaction was found to be unity in solvents of benzene and dioxane and negative in carbon tetrachloride as the solvent.

47. Studies on Differential Thermal Analysis of Catalyst Powders. Part II. The Differential Thermal Analysis of Chromic Oxide Gel.

S. N. GOPALASWAMY and S. K. BHATTACHARYYA, Bangalore.

The differential thermal analysis of chromic oxide gels prepared from chromic nitrate solution by both ammonium hydroxide and sodium hydroxide were studied. Both types of gels gave an exothermic peak at about 360°C, proving, thereby, that their thermal properties are identical. These observations are not in agreement with the results obtained by Milligan and Merten during their investigation on X-ray defraction patterns of these gels as a function of temperature.

48. Further study on mechanism of adsorption on active charcoal.

H. A. KHAN and D. S. DATAR, Hyderabad-Deccan.

Adsorption on active charcoal may be of physical nature due to capillary forces and porosity, or of chemical nature due to electrical forces and free valencies.

The adsorption of methylene blue is of the first type while that of iodine and potassium permanganate is of the mixed type.

The physically adsorbed iodine is completely recoverable but iodine held by chemical forces reacts with some substance in charcoal and it is only partially recoverable. In case of potassium permanganate, irrespective of the nature of adsorption forces, the permanganate is first adsorbed and then reacts with charcoal and is reduced to manganese dioxide. It is completely irrecoverable.

The extent of adsorption of different adsorbates when of chemical nature is proportional to their equivalent weights. In physical adsorption the amount of adsorption expressed in gm. mols is related to their molecular volumes as follows: $A \propto V^{\frac{2}{3}}$ where A is adsorption in gm. mols and V is molecular volume of the adsorbate.

49. Thermal Decomposition of Sodium Sulphate.

Miss RAZIA OSMANI and D. S. DATAR, Hyderabad-Deccan.

Sodium sulphate is another raw material in the country for the manufacture of sulphuric acid and the study of its thermal decomposition is of commercial importance. It is observed that as in the case of Gypsum the decomposition of sodium sulphate is accelerated by the addition of bauxite. At 700—800°C, the decomposition in presence of bauxite is about 85%.

Further work is in progress.

50. Adsorption of the Sols and their constituent Ions by Freshly Precipated Sparingly Soluble Salts—Part I.

A. C. CHATTERJI and M. C. RASTOGI.

Adsorption of sols of different sparingly soluble salts and their constituent ions by freshly precipitated salts have been tried with a view to test the coagulation theory of Dhar and Chatterji and Bradford's ionic adsorption theory of Liesegang ring formation. It has been found that the sparingly soluble salts can be divided into two catagories. One, having the property of adsorbing their own salts and the second which do not adsorb their own sol.

A very low percentage of ionic adsorption of constituent ions by the precipitate even when the concentrations of the reacting electrolytes were varied considerably, definitely indicate that rings formed are not due to ionic adsorption but the adsorption of the sols by the sparingly soluble salts plays a important role in their formation.

51. Role of Foreign Substances in the Release Supersaturation.

A. C. CHATTERJEE and R. P. RASTOGI.

Effect of foreign substances has been investigated. It has been found that capillary-active substances reduce the limit of supersaturation. Inorganic substance produce no effect. Dyes have a tendency to stabilize the supersaturated solution only after repeated heatings. It has been suggested that dye particles are probobly completely wetted by the solution and the limit is not lowered.

52. Temperature Dependence of Vapour pressure in Supersaturated Solutions.

A. C. CHATTERJEE and R. P. RASTOGI.

A rigorous derivation on the basis of the concept of chemical potential has been made. For the binary liquid mixtures, it has been calculated that

$$\frac{dP}{d_T} = \frac{N_1' L_1^D + N_2' L_2^D}{R_T^2 \left(\frac{N_1'}{p_1} + \frac{N_2'}{p_2}\right)}$$

For solutions of non-volatile solute the change of vapour-pressure with temperature is given by

$$\frac{dP}{d_T} = \frac{p_1 L_1^D}{R_T^2}$$

The derivations of the formulas involves no assumption, except that the vapours of the components obey the laws of perfect gases.

53. A Study of Viscosity of the System Na-Oleate-Water and Butyl Alcohol in Presence of NaC1.

A. C. CHATTERJI, A. N. BOSE and JAGDISH MISRA, Lucknow.

Viscosity of the system water-sodium oleate and n-butyl alcohol has been studied in presence of varying concentrations of sodium chloride. It has been observed that for 10, 20, 30 and 40% alcoholic concentration in 0.2N sodium oleate solution viscosity is minimum, when the NaC1 concentration is N/20 and alcoholic concentration is 10 and 20%, and for 30 and 40% NaC1 concentration is N/80. Whereas in the case of 50% alcohol solution addition of NaC1 does not decrease the viscosity. Results have been explained on the basis of hydration and the structure suggested by Harkins, Matton, Mittelmann and Corrin (J. Chem. Phys. 1946, **14**, 640; **15**, 763) for these types of solutions.

54. Variation of Electrical Conductance with Concentration of Aqueous Sodium Oleate Solutions in Presence of Different Concentrations of Alcohols, and Salt.

A. C. CHATTERJI and A. N. BOSE, Lucknow University.

Variation of specific conductance of sodium oleate-water with varying concentration of alcohols has been studied. The results have been explained on the basis of the structure that alcohol molecules arrange themselves in the pelisadel layers of oleate molecules.

55. A Study of Viscosity of the system: Water-Sodium oleate and Different Alcohols. Part I.

A. C. CHATTERJI and A. N. BOSE, Lucknow University.

Viscosity of the system: water-sodium oleate-and different alcohols, with varying concentration of alcohol has been studied. Results have been explained on the basis of the structure that the alcohol molecules arrange themselves in between the oleate molecules with their—0H group towards the water layer. The effect of NaC1 on these systems has also been studied.

56. Activity of Water and its Temperature Dependence in Supersaturated Solutions of electrolytes.

A. C. CHATTERJEE and R. P. RASTOGI.

Vapour-pressure method has been used to determine the activity of water in concentrated and supersaturated solutions. The determinations have been done at various temperatures. It has been observed that in solutions of hydrated salts the activity increases with temperature while in other cases the activity decreases with temperature. Partial molar heat content of the solvent has also been calculated.

57. Variation of Electrical Conductance with Temperature of Aqueous Sodium Oleate Solution in Presence of Different Alcohols and Salt.

A. C. CHATTERJI and A. N. BOSE, Lucknow University.

Variation of specific conductance with temperature of the system: sodium oleate-water and different alcohols has been studied. Results have been explained on the basis of the structure that the alcohol molecules arrange themselves in the palisade layer of the micelle with the solubilizate oriented in approximatelt the same manner as is the soap molecule in the micelle.

58. Adsorption Equation Applicable in solutions.

A. C. CHATTERJI and R. D. SRIVASTAVA.

An adsorption equation applicable in solutions has been deduced. The equation differs from Langmuir's adsorption equation in which number of molecules μ striking the surface of the adsorbent has been shown to be proportional to only concentration but here in solutions it has been shown that it is directly proportional to concentration and viscosity and inversly to solubility. Deduced equation is better than any single equation known is explaining the observed experimental facts. It has been shown that as viscosity increases by adding salts adsorption also increases.

59. Adsorption from mixtures by animal charcoal Pt. (I). (Effect of Salts on the adsorption of acids).

A. C. CHATTERJI and R. D. SRIVASTAVA.

Adsorption of HC1, . H_2S0_4, $HN0_3$, CH_3C00H, Oxalic, Succinic, Propionic and Butyric acids in presence of salts NaC1, $NaN0_3$. Na_2S0_4 and CH_3C00Na by animal charcoal has been studied. It is observed that salts are neither hydrolytically adsorbed nor exchange adsorption of salts takes place, but adsorption of salts takes place molecularly that means both the anions and cations are removed from solutions in equivalent amounts. Salts increase the adsorption of acids. This increase has been attributed to the fact that viscosity increases in presence of salts and solubility decreases. The increase is in accordance with our adsorption equation which shows that if viscosity will increase or solubility will decreases adsorption will increase.

60. Studies on the Adsorption from Non-aqueous Solvents. Pt. (II).

A. C. CHATTERJI and R. D. SRIVASTAVA.

Adsorption of acenaphthene and naphthalene from different solvents have been studied and it has been observed that no relation exists between the adsorption and the surface tension at air-liquid interface. But as the values of surface tension upon solubility of the solute in the solvent decreases, adsorption also in most cases decreases. The reciprocal relation between solubility and adsorption is found true only when solubility in gram moles of the solvent is taken. Relation between the polarity of the solvent and adsorption is applicable in only a group of compounds. The adsorption of naphthalene and acenaphthene is least in $CC1_4$ amongst all the solvents tried while that of benzoic acid is the largest in the same solvent.

61. Adsorption from mixtures by animal charcoal. Pt. (II). (Effect of one acid on the adsorption of other acids).

A. C. CHATTERJI and R. D. SRIVASTAVA.

Adsorption from binary mixture of acids HC1, H_2S0_4, $HN0_3$, CH_3C00H, Oxalic and Succinic acids has been studied. It is observed that the presence of a foreign substance decreases the adsorption. It has also been observed that the adsorption of binary mixtures of acids is not additive. It is not equal to the sum of the adsorption of the constituents of a mixture. The decrease in adsorption has been shown by equation due to the reduction of the total surface covered by a substance when other substance is simultaneously present.

62. Distribution of the Sparingly Soluble Salts in Periodic Structures. Part II.

M. C. RASTOGI.

Liesegang rings of six different substances have been analysed with a view to find out the amount of sparingly soluble salts in the rings and clear spaces or in the alternate bands where there occur no clear spaces.

63. Liesegang Ring formation of the Sparingly Soluble Salts of Rarer Elements in Agar-Agar and Starch Gel. Part II.

M. C. RASTOGI.

Liesegang rings of rarer elements have been obtained by usual method of diffusing electrolytes into test tubes with agar-agar or starch containing a precipitate forming electrolyte uniformly distributed in the gel.

64. Relation between Adsorption and Base Exchange Capacity of Soils.

M. R. NAYAR and V. B. S. Chauhan, Lucknow University.

In an attempt to correlate adsorption phenomenon with soil characteristics M. R. Nayar and K. P. Shukla (Current Science, 1941, Page 201) pointed out that when the Freundlich adsorption isotherm: $y = aC^{\frac{1}{n}}$ is applied to soils. the constant 'a' is a function of the base exchange capacity of the soil, 'a' being directly proportional to the square of the base exchange capacity.

Further experiments have been carried out and confirmatory results have been obtained. Seven samples of soil were collected from different sources, mechanically analysed for silt and clay and then were converted into pure calcium soils.

Adsorption experiments were carried out taking 10 gms. of the sample for each experiment and employing varying quantities of N — Na_2CO_3. Relevent data collected show that the Freundlich equation is strictly obeyed.

'a' when plotted against 'B' gives a parabola, while, 'a' plotted against 'B^2' gives a straight line; which means that 'a' varies as 'B^2' or $a = kB^2$ where k has been found to have the value: 31×10^{-5}.

The Freundlich equation then takes the form:

$$y = 31 \times 10^{-5}.\ B^2C^{\frac{1}{n}}.$$
$$y = 31 \times 10^{-5},\ B^2C^{n}.$$

65. Students on Transport Number. System: Barium nitrate—alkali nitrate—water.

M. R. NAYAR and R. C. AGGARWAL, Lucknow.

The existence of unexpected compounds between barium nitrate and potassium nitrate in solution (Nayar and Chauhan, Proc. Ind. Sc. Cong. 1949) raises the question of the role of the central Ba atom in the complex produced. A satisfactory answer can be obtained only by a determination of the transport number of the Ba-ion. This has now been estimated in solutions of barium nitrate at concentrations; M/5, M/10, M/20, and M/40 and the measurements were repeated in mixtures of barium nitrate and alkali nitrates at the same concentrations of barium nitrate. The proportion of the component salts in the mixture was kept respectively at the molecular ratios: 1:1, 2:1, 4:1 and 8:1. The concentration of the alkali nitrate was kept constant at M/5 in the series of solutions, while that of barium nitrate was varied from M/5 to M/40. The following table gives an idea of the change effected in transport number of Ba-ion.

Concn. RNO_3	Concn. $Ba(NO_3)_2$	Molar ratio $RNO_3 : Ba(NO_3)_2$	% Decrease in Tr. No. of Ba-ion in presence of.		
			$NaNO_3$	NH_4NO_3	KNO_3
M/5	M/5	1 : 1	24.9	34.9	63.3
,,	M/10	2 : 1	42.3	61.1	76.8
,,	M/20	4 : 1	58.9	76.5	78.5
,,	M/40	8 : 1	—	88.4	—

The enormous decrease in the transport number of Ba-ion in the presence of various alkali nitrates can be explained only by assuming that a part at least of the cationic barium in barium nitrate has changed into the anionic condition by forming a complex, a representative reaction being

$$\overset{++}{Ba}(NO_3)_2 + 2\ KNO_3 = K_2[Ba(NO_3)_4]^{=}$$

When a strongly electro-positive element like Ba can act as the central atom in a complex anion, it is reasonable to expect that weaker positive ions like Al in alums may similarly be in the anionic condition. This problem is being examined.

Regarding the number of complex compounds that can be formed between barium nitrate and alkali nitrates the problem is being studied in this laboratory by Messrs L. N. Srivastava and K. N. Johri.

66. Nature of Iodine Solutions, Part I.

RAM GOPAL, Lucknow.

A method for evaluating the partition coefficient for simple iodine molecules between two non-miscible liquids, into one of which iodine forms molecular complexes, has been described. The theoretical conclusions are backed by some concrete cases.

67. Induction, Dipole Moments and Infra Red Spectra.

S. K. K. JATKAR and C. M. DESHPANDE, Poona.

The inductive effects on bond moments have been the subject of numerous investigations. So far no single simple theory of calculating the induction has been found.

One of us (S. K. K. J.) in a note to 'Nature' postulated that in rigid molecules the bond moments are effected inductively by the components along the connecting links and then add up vectorially.

Thus in a triangular molecule A B A the bond moment m′ of A B is $m(1+\cos \phi)$ where ϕ is the ABA angle and the m is the free bond moment. The resultant is given by the vector of m′.

It appears that the perpendicular component is ineffective probably due to the anisotropy of the bond as can be seen by the calculation of the potential field.

The method of calculation is illustrated by examples.

68. Investigations in Viscosities of Milks.

P. S. KULKARNI and K. K. DOLE, Poona.

Viscosities of 100 samples of Buffalo milk, 80 of cow milk, 25 of goat milk and 10 of ass milk are determined with an Ostwald's Viscometer at 30°C ± 0.1°C. The samples were collected from February to August 1951, from animals fed under controlled diet and also from the bazaar. Range of Viscosities of genuine buffalo milks is 1.156 to 1.702 centipoises, that of cow milks, 1.176 to 1.458 centipoises, of goat milks, 1.101 to 1.304 centipoises and of ass milks 0.9477 to 1.060 centipoises. It is observed that viscosity of milks is a function of the contents of total solids in the milk. The ratio, (v) time of flow of milk/time of flow of water, divided by total solids is constant for a particular species. Average values of these constants are 0.0889 for buffalo milk, 0.1066 for cow milk, 0.1070 for goat milk and 0.1286 for ass milk, which indicate that they are inversely proportional to the total solids of the milks. The study of the temperature coefficients of some of the samples of buffalo and cow milk indicate that there is a linear relationship between the viscosity in centipoises and temperature, in the range of 25° to 35°C. The temperature coefficient (35°/25°) of bucalo milk is 0.7909 and that of cow milk is 0.7176.

69. Adsorption of dyes on metallic surfaces. Part VII.

D. D. KARVE, K. K. DOLE and B. W. KELKAR, Poona.

Adsorption of brilliant green, neutral red, crystal violet, aniline blue, Bismark brown has been studied on the mercury surface with a view to studying the probable mechanism of adsorption of the dyes on the metallic surfaces. Marked change in pH was observed with aniline blue and neutral red. The extent of pH changes in other dyes were comparatively less. These pH changes were observed to influence the adsorption coefficient of the dyes. The adsorption of neutral red on platinum, copper, and mercury showed that it decreased according to the place of the metal in electro-chemical series. $Cu > Hg > Pt$.

70. The X-Ray Crystallographic Structure Analysis of Complex Organic Compounds.

A. B. BISWAS, Poona.

Much of the present day theoretical chemistry rests on the result of x-ray analysis and valuable contributions have been made in recent years especially to structural Organic Chemistry. Some of the more useful methods available to the x-ray structure analysts, with examples of their applications in solving complex molecular structures, have been reviewed. The attempts that are at present being made and some important information already obtained towards the solution of the structure of proteins are given. The recently determined detailed structures of glycylglycines have been described.

71. Studies in Joshi Effect in Air-organic Vapour Mixture at Atmospheric Pressure under X-Rays.

G. V. ASOLKAR, Nagpur.

The significant finding that on addition of traces of organic liquids (e.g. C_6H_6, $C_6H_5CH_3$, $C_6H_4(CH_3)_2$, cyclohexane, $CHCl_3$, CCl_3 C_2H_5OH, CH_3COCH_3, etc.). Joshi effect ($\pm \Delta i$) is developed in Air-organic vapour mixture at atmospheric pressure which was otherwise absent in air alone at the same pressure, under X-ray irridation now reported for the first time. Thus in air-benzene mixture at atmospheric pressure with X-rays of 2.0 mA tube current and 26.3 kilo volts anode voltage. showed + 100% positive Joshi effect at 10.0 Kv exciting potential. As the exciting potential (V) was increased the $+\Delta i$ changed sign at about 11.0 kv and gave — 23.43% negative Joshi effect. With further increase in V, $-\% \Delta i$ decreased to 1.57% at 24 kv. Thus $-\% \Delta i$ was maximum at the threshold potential V_m and decreased with $(V - V_m)$. Positive Joshi-effect was observed at potentials just below V_m.

The magnitude of $-\Delta i$ depends inter alia on: (a) Frequency and intensity of X-ray beam, (b) nature and concentration of the organic vapour in air, (c) the inter-electrode distance, (d) 'ageing'.

Beyond a critical inter electrode distance (e.g. 12-13 m.m. in the case of air-benzene mixture) no $-\Delta i$ is observed. Essentially similar results are obtained with other air-organic vapour mixtures.

The results are explained from the stand point of the choking action of the positive ionic space charge by an analogy of the ozomiser discharge with that in an G. M. counter. The relation $i = Q / t_a + t_m$ where Q is the charge during $(t_a + t_m)$, t_a the active time for the collection of electrons, and t_m the traversal time of the positive ions, is examined for the changes in the discharge current under X-ray irradiation.

72. Alternating Current Electrolysis—Part I. Oxidation of Glucose.

A. N. KAPPANNA and K. M. JOSHI, Nagpur.

A study of the effect of passing alternating currents of different frequencies (3 per second to 50 per second) through a solution containing 20 gms. of potassium bromide and 180 gms. of glucose per liter in which calcium carbonate is suspended has been made. With platinum electrodes, the current efficiency at low frequencies (3 per second) is as high as about 55% reckoned on the formation of calcium gluconate. The current efficiency has been found to fall off gradually with increase in frequency-falling to 14% at frequency of 50 per second. A similar result was obtained using graphite electrodes but the efficiency is comparatively low —6.5% at a frequency of 3 per second.

With both sets of electrodes the current efficiency was found to increase with current density.

The results have been explained on the basis of difference in the rates of (1) union of bromine atoms to molecules on the electrodes and the subsequent release of bromine molecules into the solution in a half cycle and (2) the reunion of primary discharge products on the electrodes.

The lower efficiency of the graphite electrode is probably due to its greater power of adsorption towards the discharged products and its ability to promote their re-union, thus diminishing the amount of bromine released into the solution. These points have further been confirmed by a study (with both sets of electrodes) of the current efficiency of alternating currents in the liberation of bromine from solutions containing only potassium bromide. The efficiencies of bromine liberation run parallel to efficiencies in gluconate formation but are comparatively small in the former. This has been explained and shown to be due to the reduction of bromine at the electrodes after release into solution while there is no reversibility in glucose oxidation.

73. Kinetics and Reaction Mechanism of Alkali Catalysed Reaction between Phenol and Formaldehyde: Part II.

R. G. MOHAN and LOURDU M. YEDDANAPALLI, Madras.

It was shown in Part I (Abstracts, Proc. Ind. Sci Congress, 1950, p. 59) that the complex alkali catalysed reaction between phenol and formaldehyde in the temp. range, 40 to 90°C, was kinetically of second order with an activation energy of about 20,000 cals/mol. The present investigation attempts to isolate and characterise the primary step of this complex reaction leading to the phenol alcohols formation, for which purpose, the reaction kinetics were studied with increasing initial concentration of phenol(P), keeping formaldehyde(F) conc. constant, and vice versa.

Over initial P conc. range, 0.2 to 0.45 M, at constant F conc. 0.2 M and alkali catalyst conc. 0.006 M, the kinetic order is two, whereas from 0.475 upto 1.0 M conc. of P, the reaction is kinetically of first order, and the reaction rate, independent of P conc. The condensation reaction over this range being negligible, the primary addition reaction is the predominant one and therefore responsible for first order kinetics. A tentative mechanism is proposed in terms of phenate ion interacting rapidly with formaldehyde to give a semi-formal which rearranges itself unimolecularly to give phenol alcohol, involving an activation energy of about 20,000 cals/mol. The kinetics of the reaction with increasing initial F concs. are too complex to be explained at present.

74. Thermal Polymerisation in Bulk of the Monophenol from Raw Commercial Cashewnut Shell Liquid.

M. V. THAMBI and LOURDU M. YEDDANAPALLI, Madras.

The monophenol from raw commercial cashewnut shell liquid has been thermally polymerised in bulk in absence and in presence of air, and in oxygen atmosphere, at 120 to 150°C. There is little polymerisation in absence of air, some in its presence, while in oxygen atmosphere, the reaction takes place at measurable speeds. The reaction in this case, followed by viscosity measurements, is found to be kinetically of the first order, with an apparent energy of activation, about 9,000 cals/mol. The average molecular weight of the polymer under these conditions appears to correspond mostly to that of a dimer, arising from the olefinic components of the monophenol according to the generally accepted views of dimerisation of long chain, olefinic drying oils. A satisfactory explanation of the first order kinetics and the low activation energy must await further experimental investigation which is in progress in this laboratory.

75. Catalytic Cracking of the Monophenol from Raw Commercial Cashewnut Shell Liquid: Preliminary Investigation.

J. C. KURIAKOSE and LOURDU M. YEDDANAPALLI, Madras.

The monophenol from raw commercial cashewnut shell liquid has been subjected to catalytic cracking on a synthetic silica-alumina (Houdry S-46) catalyst at 375 to 450°C and at flow times 1.8 to 4 min./cc.

The gaseous products consist mainly of ethylene, propylene, butylene and their corresponding saturated hydrocarbons. Increased temp. vafours gas evolution, decreasing at the same time its unsaturated content from 50 to 40%. Increased flow rate enhances both gas evolution and unsaturation. The liquid products consist of 60% aromatics, 35% paraffins and 5% unsaturates. Over 80% of the aromatics have average molecular weight corresponding to more than 12 C atoms, indicating absence of extensive cleavage close to the nucleus. Paraffin production i favoured by lower temp. and lower flow rate. The removal of the phenolic 0H i more effective below 400° and at low flow rates.

Attempt is made to explain qualitatively the reaction products from th acidic nature of the catalyst and the general structure of the phenol.

76. Studies in the kinetics of Iodination of Hydroxylamine.

N. R. SUBBARATNAM, M.Sc. and A. K. BHATTACHARYA, D.Sc., Saugar.

In view of the recent reports about the primary and secondary reaction in the course of iodination of Hydroxylamine salts, an attempt to study in detai the "Kinetics" of the reaction in continuation of the works of Dhar and Bhattacharya under various conditions is made. Both titration and photometric method are followed to follow the reaction to ensure accuracy. Two kinds of retardin forces are found to play under different conditions together and separately, the one due to $NH_2\ 0H + 2HI \longrightarrow I_2 + NH_3 + H_20$ being possible only in presence of acids. With excess of Hydroxylamine in presence of HC1, there are three stage in the reaction with an increase in the rate in the middle stage. Effect of temperature, neutral salts, KI, Dilution etc. are also studied and rate constants recorded The effect of solvents, and the effect of light in influencing the various stages o the reaction is a subject of further study.

77. Studies in Acetone—Iodine Reaction.

K. V. NARAYAN RAO, M.Sc. and A. K. BHATTACHARYA, D.Sc., Saugar.

Halogens have been widely used as agents to study, (1) Prototropy, (R P. Bell, A. D. S. Talman, J.C.S., 1948, 370-374) and (2) Catalysis in solution (Dawson J.C.S., 1926 I.A., 1108).

Iodination of Acetone is carried out by us to detect prototropy of Acetone in dark and to bring to light the catalytic effects of organic and inorganic acids. In the former case the experiments of conductivity and pH measurements are performed using 50% Acetone and N/200 Iodine at 20 (0.1°). The conductivity values increased with time, whereas pH values decreased. The prototropic change of Acetone brings out reaction with I_2, with the result, Hydriodic acid is liberated. Since HI is an electrolyte, change in conductivity and pH values with time are accounted for.

In the second case, the following experiments are performed N/50 I_2 in KI, 50% Acetone in presence of acids like 0.1 HC1, 0.1.H_2S0_4, 0.1 Oxalic, 0.1 Acetic Acid. Further, influence of simutaneous addition of another salt of corresponding acid, is studied. The salts used are IN NaC1, IN KC1, IN NH_4C1, IN Na_2S0_4, IN K_2S0_4, IN $(NH_4)_2S0_4$, IN CH_3C00Na, IN CH_3C00K, IN CH_3C00NH, N/3 $(C00Na)_2$, N/3 $(C00K)_2$, N/3 $(C00NH_4)_2$. In absence of acids the reaction is of zero order. In absence of acid catalysts and in presence of salts also the reaction is of zero order. But in presence of Acids and Salts the reaction is of I order. The valut of K decreased according to the strength of acids. So, at the outset, it appeared that the rate of reaction is proportional to H —ions. But the proportionality factor indicates that we are not dealing with simple H^+ —ion catalysis. In every reaction irregular readings occured at the end. The variation may be due to side reaction with water. To get confirmed, now, we are proceeding with different solvents.

78. Thermodynamics of Evaporation of Liquids, Part II.

S. N. DAS and B. P. GYANI, Patna.

The average heats of condensation, Q, and the entropies of evaporation, Λ, of acetylene, n-butane, n-heptane, n-octane, n-nonane and n-decane; toluene, the isomeric xylenes, and mesitylene; methyl, ethyl, n-propyl, n-butyl, and n-amyl alcohols: and of acetone methyl chloride, methylene chloride, chloroform, and carbon tetrachloride have been calculated from their vapour pressure-temperature data. As a rule, the value of Q increases as one goes up in the homologous series of paraffins and alcohols, though not regularly. This is true of Λ for alcohols also but not for the paraffins. Among the homologues of benzene, both Q and Λ increase in the series mesitylene $<$ p-xylene $<$ o-xylene $<$ m-xylene $<$ toluene. Among the chlorine substituted methanes the Q increases with increasing number of chlorine atoms, and so does Λ. Some of the entropies of evaporation, Λ_H, have been calculated under the conditions prescribed by Hildebrand, but do not give a value in the neighbourhood of 13.7 as claimed by him, even when the liquid may be considered un-associated.

79. Adsorption by Alumina Gel.

A. P. B. SINHA and B. P. GYANI, Patna.

Adsorptive properties of one of the locally prepared alumina gels has been investigated. The water isotherms show hysteresis between adsorption and desorption which extends throughout the entire pressure ranges. The size of the hysteresis (in the plots of $x\,m$ against pressure p) is found to increase with increasing temperature. At 0°C there is only a small hysteresis which appears to vanish at —3.5. The heats of adsorption and desorption and the corresponding entropy changes have been calculated from the effect of temperature on the isotherms. It is found that both these quantities increase with the decrease in the amount of vapour taken up, $x\,m$. Both the heats and entropies of desorption are higher than those of adsorption. A larger entropy change shows that during desorption the molecules of the adsorbate in the sorbed phase may be more regularly arranged than during adsorption.

It is therefore suggested that during adsorption the molecules are mostly un-oriented in the sorbed phase, while during desorption they are mostly oriented. It is further suggested that the sorbed phase does not assume the properties of a liquid unless the prevailing pressure is quite close to the saturation pressure. These suggestions are capable of overcoming some of the difficulties inherent in the capaillary condensation theories.

80. Studies in the Determination of the Activity Co-efficient of Calcium Chloride in Aqueous Solution by Means of Electrodes of the Third kind.

J. N. SAHAY, Patna.

The present investigation arose out of observations by Robinson (Trans. Faraday Soc. 1940, **36**, 735) on the activity co-efficient of calcium chloride as found by the use of calcium amalgam electrodes. Experimental results are given for the activity co-efficient of calcium chloride deduced from the E. M. F. measurements of the cell:

Pb — Hg /PbC_20_4, CaC_20_4/$CaC1_2$(m)/AgC1 —Ag. in which m was varied from 0.001M to 0.08M.

In these experiments calcium amalgam electrodes have not been used, therefore, any objection regarding the reversibility of the calcium amalgam electrodes does not arise. The stability and reliability of this "electrode of the third" kind have been investigated in some detail. The result is of importance since a reversible calcium electrode using metallic calcium is very difficult to realise experimentally. The difficulty experienced by LeBlanc and Harnapp (Z. physik. Chem. 1933, **166A,** 321) in using the electrode $Hg/Hg_2C_20_4/CaC_20_4/Ca$ have been overcome by protecting the electrode by cellophane memberbrane. The values obtained in these investigations in dilute solutions are in fair agreement with those of the previous investigators.

81. Determination of the value of ' α ' of absolute reaction rates, for the quinhydrone system.

K. S. G. DOSS and H. P. AGARWAL, Kanpur.

When two platinum electrodes dipped in an aqueous solution containing a reversible redox system, are connected to a source of alternating current, a d. c. potential (ψ) is developed at each of these electrodes. This d. c. potential can be measured with reference to a third platinum electrode of large area, dipped in the same solution. It was established that this effect is not due to any d. c. component in the a. c. current. This phenomenon has been named the "Redoxokinetic effect" and the d. c. potential, the "Redoxokinetic potential". The theory of this effect has been formulated quantitatively for small a. c. fields which leads to the result that the ψ is proportional to the square of a. c. field (V). Further at sufficiently low frequency of a. c. field the ψ becomes independent of frequency and is given by

$$\psi = \frac{V \quad nF(\alpha - \cdot 5)}{2RT}$$

where α is a fundamental quantity introduced by Eyring and coworkers while working out the theory of Absolute reaction rates. Making use of this equation the ' α ' of the quinhydrone system in a solution of pH 7.0 has been measured and is found to be 0.4988 ± 0.0001.

82. Formation of Aggregates in Dilute Suspension of Hydrogen Clay Systems.

M. K. INDRA, Digboi.

Dilute solutions of hydrogen bentonites were previously observed to behave like colloidal electrolytes when variations in their cataphoretic velocity (C. V.) and electrical conductivity (Λ) per gram of colloid with concentration were studied. Changes in C. V., Λ and viscosity with increasing concentrations of H-clay suspensions prepared from four different clay minerals, namely, montmorillonite, kaolinite, illite and attapulgite have been compared. C. V.s have been found to increase rapidly with concentration tending towards a constant value for kaolinite, illite and attapulgite; for montmorillonite the curve passed through a maximum at or about 1.0%. A comparison of the changes in Λ shows that attapulgite has close similarity to montmorillonite up to a concentration of about 1.0%. The conductivity of kaolinite rapidly falls up to 0.5% and then decreases slowly. Illite does not show much resemblance to others. Hydrogen ion activities of H-attapulgite suspensions have been measured and found to vary linearly with concentration like those of montmorillonite. The viscosity of attapulgite like montmorillonite rises more rapidly with concentration than illite. It is thus observed that H-attapulgite has maximum resemblance to H-montmorillonite except that the concentrations at which C. V. increases and Λ decreasas do not coincide as with H-montmorillonite.

83. Thermal Conductivity of Liquid Oxygen.

SURAJDEO PROSAD.

Thermal conductivity of liquid oxygen between —179.6°C and —182°C has been calculated by the help of Nusselt equation, from the data obtained by the author on Heat Transfer Co-efficient of Condensing Oxygen Vapour.

The values agree favourably with the data of Hammann obtained by a different method.

84. Studies in Emulsions.

PASUPATI MUKERJEE.

Some physico-chemical studies have been made with xylene/water emulsions stabilised by triethanolamine oleate.

In order to ascertain to what extent the interfacial tension affects the degree of dispersion simultaneous measurements of interfacial tension and size-distribution have been made. It has been observed that when the I. T.'s are equal the size distributions and the mean sizes are also equal.

The role of the electrokinetic potential in the stability of the xylene/water emulsion stabilised by triethanolamine oleate has been studied. At low values of the potential the emulsion becomes unstable. No critical potential has, however, been found.

The interaction of cation-active and anion-active agents in the emulsion system has been investigated. When one is added to an emulsion stabilised by the other reversal of charge occurs. The ratios of the amounts of stabilisers at the iso-electric points correspond to those obtained from breaks in conductometric curves. These ratios are, however, different from those expected from stoichiometric relation. An explanation has been attempted in terms of the neutralisation of the charged micelles of the emulsifying agents used.

85. Electrokinetic Potentials of Solid Stabilised Emulsions.

S. C. RAKSHIT.

Insoluble inorganic polar compounds adsorb electrolytes strongly and as such emulsions stabilised by them are susceptible to charge reversal. Therefore, the effect of electrolytes on the breaking and electrokinetic potentials of emulsions stabilised by inorganic polar compounds was studied. The solid emulsifiers used were (i) Magnesium basic carbonate, (ii) $Mg(0H)_2$, (iii) $BaS0_4$.

Dilute emulsions of xylene/water, heptane/water were stabilised by one or the other of the above solid emulsifiers. The equibreaking concentrations of different electrolytes were determined by observing the breaking under microscope.

The electrokinetic potentials of emulsions in presence of varying concentrations of electrolytes were measured microcataphoretically. There is no critical potential at which the emulsions break. These emulsions show a marked tendency towards charge reversal-Heptane/water emulsion stabilised by $BaS0_4$ providing the extreme example of charge reversal by NaC1. Such reversal by natural univalent alkali-metal salts has not been reported with emulsions stabilised by common emulsifiers.

Zetapotentials measurements of the solid emulsifiers by electro-osmetic methods were made both in presence and absence of electrolytes. The data indicate that the sign of charge carried by the solid emulsifiers in the dispersion medium determines the sign of charge of the emulsions stabilised by them.

86. Studies on the viscosity of emulsions.

RAJAT KUMAR NEOGY.

The work embodied in the paper elucidates the viscous behaviour of emulsions with (i) variation in the nature of the internal phase, (ii) variation in the nature of the emulsifier. Attempts have also been made to correlate the data thus obtained with an emperically proposed equation extended from that of Richardson.

Benzene, Xylene and Chlorobenzene were taken as the internal phase, while emulsifiers used were saponin, sodium oleate, laurate, capriate and myristate. Viscosities were measured in a rotary viscometer of the Couette type. Our data confirmed the observations of Hatschek and Sibree that the internal phase has no effect on viscosity. Using Xylene as the internal phase and saponin and sodium salts of oleic, lauric, capric and myristic acids as emulsifiers, we have shown the marked effect that external phase produces on the viscosity of an emulsion.

Attempts have been made to fit the experimental data with the theoretical equations of Einstein and Hatschek; but the discrepancy was considerable. Richardson's equation in the form $\log \frac{\eta}{\eta_0} = K \varphi$, (i.e., a plot of $\log \frac{\eta}{\eta}$ against φ will be a straight line passing through the origin) when extended in the form $\log \frac{\eta}{\eta_0} = K \varphi + C$(plot of $\log \frac{\eta}{\eta_0}$ against φ is a straight line cutting the Y-axis in its positive direction) seem to fit the data better.

87. Chemistry of Aliphatic Thiocarbamides—Part I. Methylthiocarbamide.

R. H. SAHASRABUDHEY and RANBIR SINGH, Banaras.

Salkowki's procedure (Berichte, 1893, 2497) viz., isomerisation of methylamine-thiocyanate was found unsuitable for the preparation of methylthiocarbamid

It was prepared, therefore, by the condensation of methyl-mustard oil and ammonia. For the compound, m.p. 118 has been reported. We have found that depending on the solvent and condition of crystallisation it is obtained in two isomorphous forms m.p. 119° and 124°.

Like thiocarbamide, its interaction with bromine or other oxidising agents gives the corresponding "disulphide" oxidation product. Bromide, m.p. 203°(d). Picrate, m.p. 130°. Its iodine liberating capacity under the influence of various factors and its interaction with nitrous acid have been investigated. Close similarity with "formamidine disulphide" is found.

Stability of the methylthiocarbamide was investigated towards alkali hydrolysis: with normal caustic soda, amine, 14.2% and H_2S 5.2% and with 5 normal alkali, amine 66.6% and H_2S 100%, were found within 1 hour.

On desulphurisation with alkaline lead acetate, methylcyanamide is formed, which was isolated and identified in the form of silver derivative $CH_3.N(Ag).CN$.

Methylthiocarbamide forms various complexes with silver nitrate depending on the concentration of reactants and temperature; the following compounds have been isolated: (i) $CH_3.NH.CS.NH_2, 2AgNO_3$; (ii) $CH_3.NH.CS.NH_2, AgNO_3$; and $2CH_3.NH.CS.NH_2, AgNO_3$.

Like thiocarbamide, methylthiocarbamide can be estimated titrimetrically with iodine, the reaction being subject to similar influences as with the former.

88. Interaction of Nitrous Acid and "Formamidine Disulphide". Constitution of "Formamidine Disulphide" Salts. Part IV.

R. H. SAHASRABUDHEY and RANBIR SINGH, Banaras.

Earrier it has been suggested (These abstracts, 1951, 75) that in the interaction of nitrous acid and thiocarbamide in a strong acid medium the amino groups are not attacked but the thiocarbamide is oxidised to "formamidine disulphide" salt which most probably has the structure (CSN_2H_4), X and not $[NH_2C(:NH)S.S(HN:)C.NH_2]$, 2HX as believed hitherto.

To examine the validity of this view, we have now investigated the reaction between nitrous acid and "formamidine disulphide" hydrobromide. It has been found that the reaction produces about 25 to 30% extra nitrogen over and above that expected from the disulphide structure which has two primary amino groups only. In addition, ammonia equal to one and a half equivalent, per disulphide molecule (312 gm) was recovered from the reaction liquors. The extra nitrogen and ammonia thus corresponds to two additional $—NH_2$ groups per molecule of the disulphide. Amongst the gaseous products, besides nitrogen and nitric oxide, carbon oxysulphide has also been detected. The liquors contain thiocyanic acid which, however, is equal to an equivalent only, whereas Werner's mechanism (J.C.S., 1912, 2180) requires two molecules of HCNS per molecule of disulphide reacted.

These observations are in agreement with the monomeric formula $(CSN_2H_4)X$ which has two primary amino groups although of only half the molecular weight. The mechanism of the reaction is discussed.

89. Oxidation product of N, N-dimethyl Thio-carbamide and its interaction with Nitrous Acid. Constitution of "Formamidine Disulphide" Salts. Part V.

R. H. SAHASRABUDHEY and RANBIR SINGH, Banaras.

When a chloroform solution of as-dimethylthiocarbamide is treated with bromine in chloroform, a faint yellow powder is precipitated, which on treatment with alcohol becomes colourless, m.p. 210(d). Like formamidine disulphide salts it is hydrolysed in an aqueous medium; the acid so liberated when estimated indicates an equivalent weight of 181.5 for the hydrobromide (calculated 184). It also liberates iodine from aqueous potassium iodide and when treated with alkali, sulphur is precipitated. It gave a picrate, m.p. 117°. Molecular weight was determined in water: 0.6058 gm in 25 c.c. and 30 c.c. gave a depression of 0.345° and 0.29° respectively, corresponding with the molecular weight 127 and 125.3. In more concentrated solutions slightly higher values were obtained e.g., 1.008 gm in 25 and 30 c.c. gave a depression respectively of 0.54° and 0.44° corresponding to the molecular weights 134.4 and 137.4 respectively. Calculated molecular weight for the monomeric formula $(CSN_2H_2Me_2)Br$, is 184, and for the dimeric disulphide $(CSN_2H_2Me_2)_2\ Br_2$, 368.

Its interaction with nitrous acid was investigated, when it was found that with two equivalents of this reagent it gave almost 90 to 95% nitrogen of what could be expected on presence of two primary amino groups per 368 gms. of the compound or one amino group per molecule on the monomeric formula. From the reaction products an equivalent amount of dimethylamine was recovered. These facts support the monomeric (non-disulphide) structure of the oxidation product because a disulphide of the type of formamidine disulphide will not have in this case any primary amino group. The mechanism of the reaction is discussed.

90. Separation of Methylamines. Part I.

R. H. SAHASRABUDHEY and P. K. RAMACHANDRAN, Banaras.

From a mixture of the hydrochlorides of methyl—, dimethyl— and trimethylamine which resulted by methylation of ammonium chloride with formaldehyde, the methylamine hydrochloride can be separated by means of its insolubility in chloroform. Of the residues, dimethylamine alone reacts with carbondisulphide and alkali with the formation of sodium dimethyldithiocarbamate which can be further oxidized and precipitated as tetramethylthiuramdisulphide; the trimethylamine remains unaffected. The thiuramdisulphide is filtered and on hydrolysis with 6N H_2SO_4 gives back dimethylamine almost quantitatively. The filtrate containing trimethylamine is made excessively alkaline with sodium hydroxide and distilled; trimethylamine which comes over is absorbed in acid. Prepared mixtures (2.5 gms) of dimethylamine and trimethylamine hydrochlorides in different proportions by weight (10:90, 25:75, 50:50, 75:25 and 90:10) were subjected to above treatment, when 2.22, 1.98, 1.23, 0.65 and 0.248 gms of trimethylamine hydrochloride were recovered, the calculated values being 2.25, 1.88, 1.25, 0.625 and 0.25 gms. respectively. The quantities of thiuramdisulphide obtained were respectively 0.35, 0.90, 1.8, 2.75 and 3.4 gms and against the theoretically expected 0.37 0.91, 1.87, 2.8 and 3.37 gms. The decomposition of this last to dimethylamine was over 95% when hydrolysed with dilute sulphuric acid. The amine was recovered from the hydrolysate as usual, by distillation with alkali.

91. "Disulphide" Oxidation product of Tetramethylthiocarbamide constitution of Formamidine Disusphide; Part VI.

R. H. SAHASRABUDHEY and K. R. SESHADRI, Banaras.

A disulphide analogous to formamidinedisulphide, the oxidation product of thiocarbamide, has been reported to be formed by the oxidation of tetramethylthiocarbamide (Annalen, 1925, **445,** 36, 51). It was suggested (These abstracts, 1951, 75) that these "disulphides" are most probably not true disulphides but are derived from a single molecule of thiocarbamide or its tetramethyl homologue which has lost an electron during oxidation and co-ordinated an anion like Cl^-, Br^- etc. Extension of molecular weight determination now carried out in water gives values from 190-220 for the bromide (Me_4N_2CSBr requires 212). A structure of the type envisaged above, is likely to show similarities with a charged free radical, as indeed appears to have now been noticed: Attempts at isolating the free base from the "disulphide salt" have been unsuccessful. In addition to the liberation of iodine from aqueous KI, the compound possesses the property of oxidizing H_2S, H_2SO_3, $H_2S_2O_3$ and under certain conditions, other thiocarbamides. The "bromide", however, failed to brominate phenol or acetanilide indicating the absence of free halogen formation or a N-halogen link. It is concluded therefore, that the above peculiar behaviour arises as a result of the rather unusual type of link between the oxidized thiocarbamide residue and the 'anion'. Oxidation of mixtures of thiocarbamide and tetramethyl-thiocarbamide has revealed no mixed disulphide.

92. Separation of Methylamines. Part II.

R. H. SAHASRABUDHEY and P. K. RAMACHANDRAN, Banaras.

From a mixture of the various methylammonium bases as is usually obtained, say by methylation of ammonium chloride with formaldehyde, the tetramethylammonium hydroxide is separated being non-volatile. The methylamine can be isolated as its chloroform insoluble hydrochloride. The di— and tri— methylamines, however, are more difficult to separate. The following procedure has been found to give a fairly satisfactory separation of these and is besides quick and easy to operate.

The residues containing di— and tri— methylamines are treated with excess of carbonbisulphide and caustic soda, when the former gets fixed as sodium dimethyldithiocarbamate which is stable to boiling alkali solution and permits distillation of trimethylamine. The residues are acidified with enough sulphuric acid to make them correspond with 5 to 6 normal acid and digested at boiling temperature for about half an hour. The sodium dimethyldithiocarbamate decomposes to form dimethylamine which can be distilled after basifying the solution. From mixtures (2.5 gms) of hydrochlorides of di— and tri— methylamines in different proportions (by weight 90:10, 75:25, 50:50, 25:75 and 10:90 respectively), working along these lines 2.27, 1.85, 1.27, 0.68 and 0.24 gms dimethylamine hydrochloride and 0.30, 0.68, 1.23, 1.86 and 2.22 gms trimethylamine hydrochloride were recovered respectively, the calculated values being Me_2NH, HC1 : Me_3N, HC1, 2.25, 0.25; 1.87, 0.63; 1.25, 1.25; 0.63, 1.87; and 0.25, 2.25.

93. The Diethylthioformamide.

R. H. SAHASRABUDHEY and K. R. SESHADRI, Banaras.

When tetraethylthiuramdisulphide is heated carefully to 200—250°C, a volatile liquid distils over, a part of which condenses to a pale yellow solid. The liquid portion was identified with carbondisulphide; the solid residue on crystallisation from ether gave an almost white micro-crystalline powder (m.p. 82°C). Sulphur and nitrogen were estimated—S found 28.76%, 28.72%; N found 11.9%, 12.28% (N and S calculated for Et_2NCSH are 11.96% and 27.35% respectively). The compound is easily soluble in most organic solvents and also in cold water. Molecular weight, determined in water by cryoscopic method, was found to be 115 (Et_2NCSH requires 117). The compound is not very stable and decomposes into diethyl amine: Over 50% decomposition is observed with 2% boiling NaOH within 30 minutes and 65—67% with 20% NaOH. It is almost quantitatively hydrolysed by $6N.H_2SO_4$ within half an hour. The compound gives a white bromine addition product (m.p. 207—208°C) with a bromine content of 51—52%. It is being examined further.

94. Condensation of Methone with some Primary Aromatic Amines.

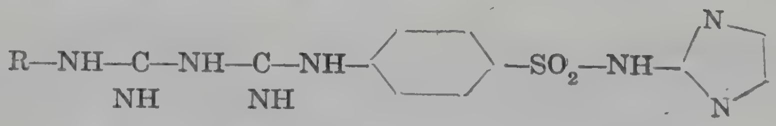
M. V. KOWJALGI and B. H. IYER, Bangalore.

In continuation of our studies with methone and its derivatives, the former has been condensed with *o*-toluidine, *o*-and *p*-xylidines, α -and β -naphthylamines, *p*-Cl—, *p*-Br—, and *p*-I— anilines, and *p*-anisidine and the products characterised.

95 Studies in Synthetic Antimalarials: Some N^4—Biguanido-benzene-N^1. 2-pyrazinyl-sulphonamides.

P. R. GUPTA and P. C. GUHA, Bangalore.

In continuation of our studies in the field of substituted sulpha-biguanides for the search of potential antimalarials, the work has now been extended to include the highly active antimalarial agent sulpha-pyrazine; and as such compounds of the following type (A) have been synthesised and tested against experimental malaria using P. gallinaceum in chicks.



Type (A)

where R = H, various aryl groupings, etc.

Compounds of the above type could only be synthesised by reacting R-cyanoguanidine with sulpha-pyrazine in a basic solvent, like pyridine, and its hydrochloride. These compounds have little tenndency to chelate with copper salts, although some of them have shown definite suppressive antimalarial action. The variation of R in certain cases, however, produced distinct dystherapeutic effect to sulpha-pyrazine.

96. Preparation of Isopropylidene-dimalonic ester.

P. R. GUPTA and P. C. GUHA, Bangalore.

Isopropylidene-dimalonic ester is a very important material for the synthesis of terpenes and their degradation products. Synthesis of Manasse's keto acid has been undertaken starting from isopropylidene-dimalonic ester. This ester has been prepared by Lawrence (J.C.S., 1899, 62) and Kotz (J.pr.Chem., 1907, **75**, 498), but the yield was never more than 10 per cent. Large number of experiments have been conducted and as the result of which it has been possible to establish a method by which an yield a 56 per cent. has been obtained.

Sodium (1/3 mole; 6 g.) was dissolved in absolute alcohol (150 c.c.). To this were added diethyl-malonate (160 g.) and isopropylidene malonate (200 g.) in dry benzene (200 c.c.). The contents left overnight at room temperature then heated for 72 hours; cooled, acidified and heated on water-bath to remove the solvent. The residue was cooled and then poured into cold water and extracted with ether. Ether was removed and ester distilled over at 190—195° at 12 mm. pressure.

97. Study of the Sesquiterpene Portion of Piper Cubeba, Linn.

R. K. RAZDAN, S. C. BHATTACHARYYA and P. C. GUHA, Bangalore.

Fruits of Piper Cubeba, Linn., have on steam distillation a greenish yellow oil in 5.7 per cent. yield, with the analytical constants $d^{28°}_{4°} = 0.8986$; $n^{28°} = 1.4885$; $(\alpha)^{28°}_{D} = 10°.7$; Acid No. = 0.30; Ester No. = 15.2; Acetyl value = 45.2.

At first the sesquiterpene portion was separated by fractionation on a column of partial condensation take off type. This, on repeated fractionation on a Tower's column, gave five distinct fractions: I, b.p. 111-12°/8.5-9 mm.; II, b.p. 126-28°/8.5-9 mm.; III, b.p. 128-30°/6 mm.; IV, b.p. 136-37°/4.5 mm.; V, b.p. 140-44/4.5 mm.; $d^{25°}_{4°}$; = 0.9811; $n^{25°}_{D} = 1.5115$; Mol. ref., 6792; Mol. formula $C_{15}H_{26}O$.

The physical constants of these fractions were determined. Fraction I gives a dihydrochloride, m.p. 117-118°, and a dihydro-bromide, m.p. 124-25°, which are identical with *l*-cadinene dihydrochloride and *l*-cadinene dihydrobromide. However, the physical properties of this fraction do not agree with that of *l*-cadinene as reported by Simonsen (J. Indian Inst. Sci., 1928, 11A, 189). It does not give a nitrosochloride and a nitroside. On sulphur dehydrogenation it gives cadalene identified as picrate and styphnate. Fractions III and IV give colour tests for azulene derivatives. Fraction V gives cadalene and an azulene (S-guaiazulene) on sulphur dehydrogenation.

98. Essential Oil from Ocimum Killimanjaricum, Guerke.

U. G. NAYAK and P. C. GUHA, Bangalore.

The plants (grown locally from the seeds imported from S. Africa) after being fermented and dried in the shade gave a maximum yield of 3.3% of an essential oil possessing the following analytical constants: $d^{30}_{30} = 0.9680$ and $d^{23}_{23} = 0.90946$ (after removing camphor which settled down on standing); $(\alpha)^{25}_{D} = +34.64$; $n^{23}_{D} = 1.4761$; Sap. Value = 17.86; Sap. Value after acetylation = 71.1.

The oil was examined in detail to determine its chemical composition and has been found to contain chiefly d-camphor, 70%; d-α-pinene, 10%; d-limonene, 5%; terpinolene, 5% and unidentified sesquiterpenes and alcohols, 10%. The oil has been reported to contain camphor and eugenol but no eugenol could be isolated from the oil distilled here.

99. Essential Oil from Mentha Aravensis.

U. G. NAYAK and P. C. GUHA, Bangalore.

The plant Mentha Aravensis (indigenous to Japan) was grown locally and yielded 0.63 per cent. oil calculated on the dry herb, the Japanese variety being known to yield 2 to 3 per cent. This oil is found to possess the following constants: $d^{25}_{25} = 0.9424$; $n^{25}_{D} = 1.4882$; $(\alpha)^{25}_{D} = +21°.82$; acid value = 1.5; sap. value = 39.9; sap. value after acetylation = 141; combined menthol 13.5%; free menthol 49.5% (Japanese variety 70-80%). It is peculiar that the oil distilled here shows a dextro-rotation, the Japanese variety is known to possess laevo rotation.

100. Essential Oil from Ocimum Gratissimum, Roxb.

U. G. NAYAK and P. C. GUHA, Bangalore.

The plant grown locally here in Bangalore from the seeds obtained from Russia gave an essential oil in a yield of 0.53% (calculated on the herb dried in the shade), whereas the Indian and Seychelles varieties gave 0.1%. The oil is dark brown in colour and possesses the following analytical constants: $d^{25}_{25} = 0.9395$; $n^{25}_{D} = 1.5152$; $(\alpha)^{25}_{D} = -18°.1$; sap. value = 15.71; sap. value after acetylation = 124.8.

The oil was examined in order to determine its composition and was found to contain chiefly Ocimene (15%), eugenol (61.8%) and unidentified alcohols (10%). The oil from the Seychelles variety examined by Roberts has been shown to contain Ocimene and eugenol as the chief constituents. The components of these two Russian and Seychelles varieties seem to be the same but it is quite strange that the components of the oil from the Indian variety examined by Nigam and Dutt are quite different though by name the plant they have used seems to be the same botanically as the plant used by us. This view of ours is also supported by Guenther who says that in the case of this type of oil examined by Nigam and Dutt there is some doubt as to the botany of the parent plant.

101. Studies in Quinolyl-biguanides.

Part A: N^1-(7-chloro-8-quinolyl)—N^5-substituted.

Part B: N^1-(5-chloro-8-quinolyl)—N^5-substituted biguanides.

P. R. GUPTA and P. C. GUHA, Bangalore.

In continuation of the work on the synthesis of quinoline substituted biguanide derivatives as possible anti-malarial and anti-bacterial agents (Gupta and

Guha, Curr. Sci., 1948, **17,** 185; Sirsi, Gupta and Rao, Curr. Sci., 1950, **19,** 293), two series of compounds possessing the chloro-amino-quinoline and the biguanide moities, (present in the active antimalarials) have been synthesised in order to test their chemotherapeutic activity against avian malaria and certain gram positive and negative organisms.

Chlorine atom has been introduced into different position of the quinoline nucleus to study the effect of its presence in the various positions on the chemotherapeutic activity.

Part A: By the action of 7-chloro-8-amino-quinoline hydrochloride on the corresponding cyanoguanidines, some biguanides with the following substitutions have been prepared: N^1-(7-chloro-8-quinolyl)- N^5-. (i) biguanide, m.p. 209°; (ii) phenyl—, m.p. 184°; (iii) p-chloro-phenyl—, m.p. 157—58°; (iv) *p*-bromo-phenyl—, m.p. 160°; (v) p-tolyl—, m.p. 152—3°; (vi) *p*-anisyl—, m.p. 188°; (vii) *m*-chloro-phenyl—, m.p. 162-3°.

Part B: In the second series, 5-chloro-8-amino-quinoline hydro-chloride was made to react with the appropriate cyanoguanidines giving the following substituted biguanides: N^1-(5-chloro-8-quinolyl)—N^5-, (i) simple biguanide, m.p. 187°; (ii) phenyl—, m.p. 186°; (iii) *p*-chlorophenyl—, m.p. 202°; (iv) *m*-chloro-phenyl—, m.p. 188-89°; (v) *p*-bromo-phenyl—, m.p. 207°; (vi) *p*-iodo-phenyl—, m.p. 204°; (vii) *p*-tolyl—, m.p. 193°; (viii) *p*-anisyl—, m.p. 185°; (ix) *p*-xylyl—, m.p. 176°.

All of the compounds mentioned above in both the series decompose at their melting points. Out of the compounds tested so far against P. gallinaceum in chicks, compound No. IV of part A has shown a very high suppressive antimalarial activity. Besides, some of the quinolyl-biguanides showed antibacterial activity against certain pathogenic micro-organisms even at a very high dilution.

102. Preparation of Amines: Simultaneous Hydrogenation and Ammonolysis of Ketones.

S. S. GUHA and P. C. GUHA, Bangalore.

Of all the methods described in literature (Goldschmidt, Ber., 1887, **20,** 728; Tafel and Pfeffermann, Ibid., 1902, **35,** 1514; Tseng and Chang, Amer, Chem. Abst., 1937, **31,** 95; Takki and Ueda, J. Pharm. Soc., Japan, 1938, **58,** 296) for the preparation of isopropylamine, the method developed in this laboratory (Bami, Iyer and Guha, J. Indian Inst. Sci., 1947, **29A,** Part II, 9-14) was found to be the most satisfactory. This new method of preparation of isopropyl amine has been further developed by our own devised equipment for the preparation of 3 ℔s. of the amine per charge. A number of cyclic amines and substituted isopropyl amines of the type $R.CH_2.CH.NH_2.CH_2.R'$ (where $R' =$ aryl and $R= H, CH_3$, etc.) were made by the direct ammonolysis with hydrogenation of the corresponding ketones in presence of a Raney's nickel as catalyst.

This very interesting process of hydrogenation with ammonalysis of ketones were found not to be applicable for the preparation of bicyclic amines from the corresponding ketones like camphor and thujone.

103. Studies in Antimalarials, Part III. Some aryl and alkyl carbo-diguanidines.

S. K. DEB, S. S. GUHA and P. C. GUHA, Bangalore.

Some guanidine derivatives (King and Tonkin, J.C.S., 1946, 1063) and some biguanides ("Paludrine", Curd and Rose, J.C.S., 1946, 729) have recently been found to be endowed with good antimalarial properties. With the idea of examining their antimalarial properties some carbo-biguanidines of the type A have been synthesised.

R.NH.C(:NH).NH.C(:O).NH.C(:NH).NH.R Type A

(where R = various alkyl, and substituted or unsubstituted aryl groupings).

It will be observed that in the cases of the compounds of the above type the two guanidine residues have been separated by a carbonyl group. Compounds of the above type were synthesised by reacting one molecule of carbonyl chloride with two molecules of the corresponding guanidine base in an inert solvent like benzene or acetone. The carbo-biguanidines are now undergoing pharmacological examinations.

Carbo-biguanidines (type A): R = (i) phenyl (m.p. 102°); (ii) *p*-chlorophenyl (m.p. 128°); (iii) *p*-bromophenyl (m.p. 144°); (iv) *p*-iodophenyl (m.p. 133°); (v) *p*-xylyl (m.p. 238°); (vi) methyl (m.p. 198°).

104. Studies in Antimalarials, Part IV. Some aryl and alkyl sulphuryl diguanidines.

S. N. SUR, S. S. GUHA and P. C. GUHA, Bangalore.

In view of the guanidines and biguanide derivatives possessing antimalarial properties (King and Tonkin, J.C.S., 1946, 1063) and also because some of the sulpha drugs having been proved to possess pronounced antimalarial properties (e.g. sulphadiazine, Findlay, Ann. Trop. Med. and Parasitol, 1946, **40,** 358), it was considered worthwhile to prepare compounds in which there will be a combination of $S0_2$ group with guanidine residues and which may be called sulphuryl diguanidines (type A).

$R.NH.C(:NH).NH.SO_2.NH.C(:NH).NH.R$ (type A)

where R = various alkyl and substituted or unsubstituted aryl groupings.

The sulphuryl diguanidines have been prepared by reacting 1 mol. of sulphuryl chloride with 2 mols. of corresponding guanidines in inert solvent like benzene.

Sulphuryl diaguanidines (type A): R = (i) chlorophenyl (m.p. 212°); (ii) bromophenyl (m.p. 216°); (iii) *p*-iodophenyl (m.p. 158°); (iv) methyl (m.p. 215°); (v) *p*-xylyl (m.p. 287°).

The screening of the above compounds in avian malaria is under progress.

105. Studies on Antimalarials, Part V. Some N^1—and N^3—substituted Derivatives of Metanilamide.

K. V. VISWANATHAN, M. RAGHAVAN and P. C. GUHA, Bangalore.

Metachloridine (2-metanilamido-5-chloro-pyrimidine) as also metanilamide are known to be endowed with important chemotherapeutic properties (J. Amer. Chem. Soc., 1946, **68,** 1093; J.parasitol, 1948, **34,** 290; Mietzsch and Bauer, U. S. 2, 299, 555, Oct. 20, 1942).

With a view to exploring further possibilities of getting antimalarial drugs, the following N^1—and N^5—substituted metanilamide compounds have been synthesised: (i) *m*-Sulfamyl phenyl urea, m.p. 182°C; (ii) *m*-Sulfamyl phenyl thiourea, m.p. 164—66.5°C; (iii) *m*-Sulphamyl phenyl biguanide hydrochloride, m.p. 234°C; (iv) N^1—(*m*-sulfamyl-phenyl)-N^5-*p*-chlorophenylbiguanide hydrochloride, m.p. 215-216°C; (v) *m*-Nitrobenzene-sulfonyl urea, m.p. 176°C; (vi) N^1-(*m* nitrobenzene-sulfonyl)-N^5-*p*-chlorophenyl-biguanide, m.p. 188.5—189.5°C. Compounds (v) and (vi) on reduction will give the amino derivatives. Further work is in progress.

106. Studies in Antimalarials, Part VI. Some N^1—and N^5—substituted Biguanides.

K. RAMAN, M. RAGHAVAN and P. C. GUHA, Bangalore.

Following the discovery of the unique antimalarial properties of "Paludrine" (N^1-*p*-chlorophenyl-N^5-isopropyl-biguanide) by Curd and Rose (J.C.S., 1946, 729), many attempts have been made to improve upon the activity of the parent drug.

Considering that a suitable substituted biguanide system may be sufficient for antimalarial activity (Curd and Rose, Nature, 1946, 158, 707), a series of compounds of type A have been prepared in which the isopropyl group of "Paludrine" is replaced by the sulphanilyl residue.

$X.C_6H_4.NH.C(:NH).NH.C(:NH).NH.SO_2.C_6H_4.NH_2$ (type A)

($X = Cl, Br, I$).

These compounds have been prepared by reacting halagenophenyl biguanides with *p*-nitrophenyl sulyhonyl chloride and then reducing the nitro to the amino group.

(i) N^1-p-chlorophenyl-N^5-(p-aminobenzene-sulphonyl)-biguanide, m.p. 178-9°

(ii) N^1-p-bromophenyl-N^5-(p-aminobenzene-sulphonyl)-biguanide, m.p. 198°

(iii) N^1-*p*-iodophenyl-N^5-(p-aminobenzene-sulphonyl)-biguanide, m.p. 204°

Further work is in progress.

107. Studies in Antimalarials, Part VIII. Bisamidino Sulphides.

L. NEELAKANTAN and P. C. GUHA, Bangalore.

Various biguanide derivatives have been proved to be useful synthetic antimalarials. It was hence decided to study the activity of compounds with a similar structure to these biguanides with the NH in position 3 substituted by a Sulphur atom. Thus various derivatives-bis-diamidino sulphides—were prepared by reacting 1 molecular proportion of dicyanogen sulphide with two of various amines like aniline, p-chloro-aniline, p-anisidine, p-toluidine, p-nitraniline, ammonia, dimethylamine, diethylamine and benzylamine, to give the corresponding bisamidino sulphides. Further work is proceeding in this connection.

108. Studies in Antimalarials, Part VII. N-Substituted 2:6-diphenyl pyridones.

L. NEELAKANTAN and P. C. GUHA, Bangalore.

Various N-substituted 2:6-diphenyl-γ-pyridones have been prepared with a view to studying their antimalarial property. Thus various aryl and other substituted biguanides as phenyl, p-chlorophenyl, p-anisyl, p-tolyl, p-nitrophenyl, isopropyl, biguanides were reacted with 2:6-diphenyl-γ-pyrone to give the corresponding N-biguanyl 2:6-diphenyl pyridones.

In this connection S-methyl-isothiourea was also reacted with 2:6-diphenyl-γ-pyrone to give the corresponding derivative which on further reaction with ammonia, dimethylamine, diethylamine, benzylamine and guanidine gave the corresponding N-amidino-2:6-diphenyl-γ-pyridones.

109. Azo-dyes of 4:4'-diamino-diphenyl sulphone.

J. R. IYENGAR, S. C. BHATTACHARYYA and P. C. GUHA, Bangalore.

Considering the fact that Prontosil and other azo dyes of sulphanilamide series show very remarkable anti-bacterial properties, 21 tetrazo dyes have been prepared by condensing the tetrazo derivatives of diaminodiphenyl sulphone with various phenols and amines. The general formula is as follows:

$$R.N = N.C_6H_4.SO_2.C_6H_4.N = N.R$$

where R represents residues of aromatic hydroxy and amino compounds, e.g., phenol (m.p. 249-50°); resorcinol (m.p. 260°); *p*-cresol (m.p. 235-36°; *m*-cresol (chars at 240°); *p*-bromophenol (m.p. 208-10°); *p*-nitrophenol (chars at 280°); napthionic acid (m.p. above 300°); carvacrol (m.p. 180°); thymol (m.p. 160°); salicylic acid (m.p. above 285°); p-amino-salicylic acid (m.p. above 305°); α-naphthol (m.p. above 245°); β-naphthol (m.p. 267-68°); aniline (m.p. 170-72°); dimethylaniline (m.p. 224-25°); diethyl-aniline (m.p. 260-62°); *p*-toluidine (m.p. 120-22°); *o*-xylidene (m.p. 189-90°); *p*-xylidene (m.p. 175-76°); α-naphthylamine (m.p. 249-50°); β-naphthylamine (m.p. 205-206°).

110. Thio-ureas of Sulphones and Sulphides.

J. R. IYENGAR, S. C. BHATTACHARYYA and P. C. GUHA, Bangalore.

With a view to studying the chemotherapeutic effect on the substitution of the amino groups of sulphones and sulphides, thio-ureas derivatives of the general formulae (types I, II, III and IV) have been prepared by the action of mustard oils on sulphones and sulphides.

$R.NH.CS.NH.C_6H_4.SO_2.C_6H_4.NH.CS.NH.R$ Type I

where R = phenyl (m.p. 212-13°); *p*-chlorophenyl (m.p. 197-98°); *p*-bromophenyl (m.p. 190-91°); *p*-iodophenyl (m.p. 192°); allyl (m.p. 180-81°); *o*-tolyl (m.p. 205-206°); *m*-tolyl (m.p. 209-210°); *p*-tolyl (m.p. 207-208°); *o*-xylyl (m.p. 210-211°); *p*-xylyl (m.p. 245-46°).

$R.NH.CS.NH.C_6H_4.SO_2.C_6H_4.NO_2$ Type II

where R = phenyl (m.p. 180°); *p*-Bromophenyl (m.p. 92°); *p*-iodophenyl (m.p. 84°); and allyl (m.p. 176°).

$R.NH.CS.NH.C_6H_4.S.C_6H_4.NH.CS.NH.R$ Type III

where R = phenyl (m.p. 185°); *p*-chloro-phenyl (m.p. 194°); *p*-bromo-phenyl (m.p. 186°); *p*-iodo-phenyl (m.p. 190°); allyl (m.p. 158°).

$R.NH.CS.NH.C_6H_4.SO_2.C_6H_4.NO_2$ Type IV

where R = phenyl (m.p. 189°); *p*-bromophenyl (m.p. 124°); *p*-chlorophenyl (m.p. 131°); *p*-iodophenyl (m.p. 185°); allyl (m.p. 146°).

Some of these compounds show marked anti-tubercular properties in in vitro tests.

111. Some derivatives of 4:4′-Diaminodiphenyl sulphone.

B. N. JAYASIMHA, S. C. BHATTACHARYYA and P. C. GUHA, Bangalore.

In view of the toxic properties possessed by 4:4′-diamino-diphenyl sulphone, derivatives with substituents in the amino-groups have been prepared. Substituted bis-biguanido and bis-guanido derivatives are obtained by condensation of 4:4′-diaminodiphenyl- sulphone hydrochloride with suitable cyanoguanidines and cyanamides. Attempts are being made to synthesise, derivatives of 4:4′-diamino-diphenyl sulphone with dicerent substituents on the amino groups. Alkyl and other substituaed derivatives are also being prepared. Some of the compounds have shown interesting results in in vitro tests, against tubercle bacilli.

112. Studies on Essential Oil from the Wood of Lansium Anamalayanum, Bedd.

A. SOMASEKARA RAO, S. C. BHATTACHARYYA and P. C. GUHA, Bangalore.

The essential oil from Lansium Anamalayanum Bedd. consists chiefly of two sesquiterpenes. The lower boiling fraction is a new sesquiterpene for which the name Chigadmarene has been assigned. The higher boiling fraction is bisabolene. Pure chigadmarene has the following properties: b.p. 117-118°/9 mm.; 108°/5 mm.; $\alpha_D = -150°$; $n^{28} = 1.4953$; $d^{28}_{4} = 0.9024$.

The structure of chigadmarene has been determined with the held of (a) dehydrogenation (when S-guaiazulene is formed); (b) infra-red absorption spectrum (taken at M. I. T.); and (c) ozonolysis.

Ozonolysis of chigadmarene ($C_{15}H_{24}$) gives a compound of formula $C_{14}H_{20}O_2$ which contains one double bond; both the oxygen atoms are present as $-CO.CH_3$ groups.

113. A study of the Essential Oil from the Oleo-resin of Dipterocarpus Indicus.

G. S. KRISHNA RAO, SUKH DEV and P. C. GUHA, Bangalore.

A study of the essential oil from the oleo-resin of Diptero-carpus indicus by Mansukhani and Sudborough (J. Indian Inst. Sci., 1918, **20** (iii), 29) showed the presence of only α -caryophyllene (humulene). But during the course of the present work, a study of the several fractions of the essential oil revealed the presence of humulene and β -caryophyllene, isolated by repeated purification chromatographically and identified by the preparation of characteristic derivatives. The presence of a sesquiterpene hydrocarbon and an alcohol both giving cadalene on dehydrogenation is also indicated and a preliminary study of these substances given.

114. A study of the Essential Oil from the wood of Cedrus Deodara.

G. S. KRISHNA RAO, SUKH DEV and P. C. GUHA, Bangalore.

The essential oil from the wood of Cedrus deodara was previously studied by Roberts (J.C.S., 1916, **109**, 791), Rau and Simonsen (Indian Forest Records, 1922, **9**, 123) and Pfau and Plattner (Helv. Chim. Acta., 1934. **17**, 129) who reported the presence of p-methyl—Δ^3-tetrahydroacetophenone, a cadinenic sesquiterpene hydrocarbon, a sesquiterpene alcohol and sesquiterpene ketones named atlantones in the oil. The present study of the oil revealed the presence of two sesquiterpene hydrocarbons named α — and β — himachalenes and an alcohol named himachalol (all the three inter-related to each other as evidenced by the formation of the same dihydro-chloride from all of them) besides p-methyl acetophenone, p-methyl—Δ — tetrahydro-acetophenone and atlantones.

115. Effect of Butylated Hydroxy Anisole on the Stability of Oils and Hydrogenated Fats.

V. H. KAPADIA and N. G. MAGAR, Bombay.

Effect of addition of propyl gallate, N.D.G.A., Ionol and Butylated hydroxy anisole on the stability of groundnut, sesame and coconut oils at 37°C and during frying of 'purees' at 200—210°C, was noted by observing the development of rancid odour and peroxides. B.H.A. (.02%) did not give better protection than the other antioxidants used at 37°C storage. The carry-over property of the antioxidants tried, was not satisfactory during frying in oils.

Different brands of hydrogenated (vegetable) fats were also tested for their stability towards oxidative rancidity. At 37°C, storage, both Ionol and P. G. were found to be effective. B. H. A. was, however, not effective; not was it carried over during frying of hydrogenated fats. Combination of B. H. A., P. G. and citric acid was, however, found to be effective during frying of hydrogenated fats.

116. Synthesis of Thiophenes and Thiapyrans, Part VII.

K. RABINDRAN and B. D. TILAK, Bombay.

Dibenzothiophene (I), which has been synthesised earlier by several methods, occurs in Coal-tar together with crude phenanthrene and is used as a dyestuff-intermediate and also in the synthesis of physiologically active compounds. It has now been prepared by a new synthesis starting from thiophenol and α-bromocyclohexanone. The condensation of the latter two substances gave α-phenylmercaptocyclohexanone (yield, 77%) which on cyclisation by treatment with phosphorus pentoxide at 170—180° gave tetrahydrodibendothiophene (yield, 74%). Dehydrogenation of the tetrahydroderivative by the action of selenium at 300°C for 22 hours gave dibenzothiophene (yield, 91%).

Starting from arylthiols and α-bromocyclohexanone, new substituted derivatives of (I) as well as its higher polycyclic derivatives hitherto inaccessible may now be synthesized by the above method. With a view to demonstrate the application of the above synthesis of dibenzothiophene to its substituted and its higher polycyclic derivatives, the following new compounds were synthesized starting from the appropriate thiols and α-bromocyclohexanone:—

3-Methyldibenzothiophene; 4-methyldibenzothiophene; 3:4-benzodibenzothiophene.

NAPTHAQUINONE SERIES

117. Brazanquinone vat dyes from 2:3-dichloro-1:4-naphthoquinone.

B. SURYANARAYANA and B. D. TILAK, Bombay.

2:3-Dichloro 1:4 naphthoquinone (I) reacts with phenols substituted in the *m*-position with groups such as a hydroxyl, amino, alkyl or aryl amino and with α -and β-naphthols with an unsubstituted ortho-position to the hydroxyl group giving 3-substituted brazanquinones and benzobrazanquinones respectively, which contain the furan ring system. These derivatives although highly coloured and vattable, had little or no substantivity to cotton.

Condensation of (I) with napsthols and their derivatives has now been further investigated with a view to synthesise useful vat dyes. 2-Hydroxy-3-naphthoic anilide (Naphtol-AS) condensed with (I) in the same way as -naphthol to give 1:2-benzobrazanquinone-4-carboxyanilide (II) which had good substantivity to cotton. The increased substantivity is due to the introduction of the carboxyanilide group in 1:2-benzobrazanquinone. Introduction of heterocyclic rings, carboxyamide groups, halogen atoms and methoxy groups and increase in structural complexity has been found to promote substantivity in the Naphtol-AS series. A similar study has now been undertaken in the brazanquinone vat dyes which were readily prepared by condensing (I) with α-and β -naphthols and their derivatives and by condensation with the azoic coupling components of the Naphtol-AS series. Their dyeing and fastness properties have been studied.

The range of shades obtainable from the above dyes varies from yellow to violet, although most of them dye bright yellow or orange-yellow shades. Their fastness properties and substantivity are satisfactory in most cases.

In contrast to the Naphtol-AS series, where increase in structural complexity leads to increased affinity to cotton, among the brazanquinones no such marked effect could be observed and even the parent 1:2-benzobrazanquinone-4-carboxyanilide (II) had good substantivity to cotton.

118. Pechmann Condensation of Some 2:5-Disubstituted Phenols.

R. N. USGAONKAR, R. C. SHAH and G. V. JADHAV, Bombay.

The formation of a chromone derivative during the Pechmann condensation in presence of concentrated sulphuric acid was noted by Mody and Shah (Proc. Indian Acad. Sci., 1951, 34A, 77). To get more evidence which would help in elucidating this behaviour, condensations were carried out with several 2:5-disubstituted phenols, namely, 2-ethyl-5-methylphenol, 2-ethyl-4-bromo-5-methylphenol, thymol (2-isopropyl-5-methylphenol) and 4-bromothymol and ethyl acetoacetate and ethyl α -methylacetoacetate. The condensing agents used were concentrated sulphuric acid, anhydrous aluminium chloride (nitrobenzene), phosphorus oxychloride and phosphorus pentoxide. The results can be summarised as below.

1. 2-Ethyl-5-methylphenol and thymol with ethylacetoacetate furnished 4:7-dimethylcoumarin, the ortho-alkyl groups being eliminated, when anhydrous aluminium chloride was used. The former yielded the same product even when concentrated sulphuric acid was employed.
2. They furnished 2:5-dimethyl-8-ethyl— and 2:5-dimethyl-8-isopropyl-chromones in presence of phosphorus pentoxide.

3. On condensation with ethyl α-methylacetoacetate, 2:3:5-trimethyl-8-ethyl— and 2:3:5-trimethyl-8-isopropyl-chromones were formed, when phosphorus oxychloride was used. This was also the case with phosphorus pentoxide.
4. 4-Bromo derivatives of both these phenols, however furnished a chromone derivative even in presence of concentrated sulphuric acid, phosphorus pentoxide giving the same products.

The observation on elimination of alkyl groups during Pechmann condensation in presence of concentrated sulphuric acid is interesting; so also is the observation on the formation of chromones with this condensing agent. Further work in this direction is in progress.

119. Studies in chalkone derivatives—Study of the reactivity of the chalkone dibromides.

G. V. JADHAV and V. G. KULKARNI, Bombay.

Chalkones were prepared from 5-nitro-resacetophenone and 3-bromo-5-nitro-resacetophenone by condensing them with aldehydes such as benzaldehyde, salicylaldehyde, 3:5-dibromo-salicylaldehyde, o-methoxy-benzaldehyde, anisaldehyde, 3-bromo-anisaldehyde, vanilline and 5-bromo-vanilline, with a view to study the effect of substituents in the ketone towards the reactivity of the dibromides of these chalkones with various reagents.

Bromination with varying amounts of acetic acid solution of bromine and with liquid bromine gave different products. The reactivity of chalkone dibromides was studied with (i) potassium iodide solution, (ii) potassium hydroxide, (ii) sodium ethoxide, (iv) potassium cyanide, (v) pyridine, (vi) dimethylaniline and (vii) borax.

Potassium iodide always gave the chalkones and other reagents always formed benzylidene coumaranines, which gave deep red coloration with concentrated sulphuric acid.

The work was extended to derivatives of 5-nitropeanole also.

120. Fries and Friedel-Crafts Reactions in Coumarins.

R. J. PARIKH and V. M. THAKOR, Bombay.

The application of Fries rearrangement to esters of hydroxycoumarin derivatives has been lately studied in detail by several workers; however, little work has been carried out on Friedel-Crafts acylation of hydroxycoumarin derivatives. In the present case, Fries and Friedel-Crafts reactions have been carried out with several hydroxycoumarin derivatives.

Thus 7-hydroxy-4-methylcoumarin with acetyl chloride or acetic anhydride gave 7-hydroxy-4-methyl-8-acetylcoumarin; 5-hydroxy-4-methylcoumarin furnished acetic anhydride or acetyl chloride 5-hydroxy-4-methyl-6-acetylcoumarin, and with benzoyl chloride 5-hydroxy-4-methyl-6-benzoylcoumarin; 5-hydroxy-4:7-dimethylcoumarin with acetic anhydride yielded 5-hydroxy-4:7-dimethyl-6-acetylcoumarin; and 5:7-dihydroxy-4-methylcoumarin, 5:7-dihydroxy-6-acetyl—and 5:7-dihydroxy-6:8-diacetyl-4-methylcoumarins.

6-Acetoxy—and 6-benzoyloxycoumarins easily underwent Fries transformation to furnish 6-hydroxy-5-acetyl—and 6-hydroxy-5-benzoylcoumarins. The same products were obtained on Friedel-Crafts acylation of 6-hydroxycoumarin with acetic anhydride or acetyl and benzoyl chlorides.

121. Bromination of 5-hydroxy-4, 7-dimethylcoumarin and its methyl ether.

R. J. PARIKH and SURESH SETHNA,Baroda.

5-Hydroxy-4, 7-dimethylcoumarin and its methyl ether have been brominated with one mole, two moles and excess of bromine. The first bromine atom has been found to enter the 8-position and the second enters the 6-position in the case of the hydroxy coumarin. In the case of the methoxy coumarin the first bromine atom enters the 8-position but the second one enters the 3-position as seen from the formation of a coumarilic acid derivative on hydrolysis of the dibromo compound. With excess of bromine the 3, 6, 8-tribromo derivative is obtained in both the cases.

122. Bromination of 5-Hydroxy-2-methylchromone.

R. M. NAIK (Bombay) and SURESH SETHNA (Baroda).

The bromination of 5-hydroxy-2-methylchromone has been systematically studied. With one molecule of bromine 5-hydroxy-2-methylchromone afforded a monobromo derivative to which the structure of 5-hydroxy-2-methyl-8-bromochromone has been assigned, as the mononitro derivative of this product was found to be different from the monobromo product of 5 hydroxy 2 methyl 8 nitrochromone and both these compounds gave 2-acetyl-4-nitro-6-bromoresorcinol on heating with alkali.

With two molecules of bromine, a dibromo derivative was obtained to which the structure of 5-hydroxy-2-methyl-6:8-dibromochromone has been assigned, as on hydrolysis with alkali, it yielded 2-acetyl-4:6-dibromoresorcinol which has been assigned, as on hydrolysis with alkali, it yielded 2-acetyl-4:6-dibromoresorcinol which has been prepared by the bromination of 2-acetylresorcinol.

With excess of liquid bromine a tribromo derivative was obtained which could not be degraded by alkaline hydrolysis to a definite product. The structure of 5-hydroxy-2-methyl-3:6:8-tribromochromone has been tentatively assigned to this product.

The action of nitric acid on bromo compounds has been studied and it is found that the bromine atoms are progressively replaced by nitro groups. 5-Hydroxy-2-methyl-6:8-dibromochromone afforded 5-hydroxy-2-methyl-8-bromo-6-nitrochromone with acetic acid and nitric acid at room temperature, and 5-hydroxy-2-methyl-6:8- dinitrochromone with acetic acid and nitric acid at 100°. 2-Acetyl-4:6-dibromoresorcinol gave 2-acetyl-4-nitro-6-bromoresorcinol on treatment with a mixture of nitric acid and acetic acid at 0°.

123. Studies in the Catalytic Liquid-Phase Oxidation of Quinoline to Nicotinic Acid.

S. K. SAHA, Calcutta.

Attempts have been made to oxidise quinoline by Sulphuric acid in presence of the more easily available oxidation catalysts like iron. mercury and copper salts and their mixtures as also halogens or compounds of halogens yielding halogens on treatment with sulphuric acid for the preparation of nicotinic acid. Good results have been obtained with the mixed catalyst—Ferric sulphate and copper sulphate—when quinoline is oxidised by sulphuric acid in its presence at 300—330°C. Oxidation of quinoline by sulphuric acid in presence of idoine is more encouraging, and further studies are in progress.

124. Studies on the Stability of Thiamine Mononitrate and Hydrochloride in Pharmaceutical Preparations.

G. C. ESH, Calcutta.

The stability of thiamine chloride has been compared with that of thiamine mononitrate, a recently available salt in various pharmaceutical preparations covering a period of six months in order to see whether mononitrate can be profitably substituted for by hydrochloride. In any solution sterilised by autoclaving both the salt deteriorated to the extent of 12—13% and there is no significant difference between the two salts in this respect. In B Complex Elixir preparations though loss occurred with both the salts, the nitrate tended to resist deterioration a little better than the hydrochloride. The presence of iron salt aggravates the deterioration much in case of hydrochloride and only a little in case of nitrate. Light seems to accelerate the decomposition of the vitamin.

125. Synthesis of 8-Aminoquinolines.

ACHINTYA KAMAL SEN and AMITABHA RAY-CHOUDHURI, Calcutta.

In view of the observation on the greater antimalarial activity than Paludrine of N′-p-bromophenyl-N^5-isopropylbiguanide (cf., Ainley, Curd and Rose, J. Chem. Soc., 1949, 100), N′-(6-methoxy-8-quinolyl)-N^5-(*p*-bromophenyl) biguanide and the corresponding *p*-tolyl analogue has now been synthesised, the pharmacological examination of which as carried out in the pharmacological section of the Bengal Immunity Research Institute against *p.* gallinaecum and *p.* relictum in fowls and chicks respectively reveals that these compounds are not so active.

126. Search for New Antispasmodics. Part IV.

T. N. GHOSH, A. K. KUNDU and A. RAY-CHOUDHURI, Calcutta.

In recent years it has been fully established that the Mannich reaction with substituted phenols gives rise to *O*-cresol derivatives. Price and Jackson (J. Amer. Chem. Soc., 1946, 68, 1282) have introduced tertiary basic group into the 3-position of 7-methoxy-2-methyl-4-hydroxy-quinoline by Mannich reaction and have fully established the constitution of the resulting product. In view of this finding, the product obtained by condensing 2-methyl-4-hydroxy-quinoline with formaldehyde and a secondary amine (diethylamine or piperidine) has now been assigned the structure: 2-methyl-3-diethylamino (or piperidino)-methyl-4-hydroxyquinoline (I) and not the structure in which the 2-methyl group has been ascribed to be involved in the condensation by a German patent (Friedl., 1931, **16**, 2669). This is supported by the observation that the compound (I). with $POCl_3$, yields the corresponding 4-chloro-derivative (II). On catalytic hydrogenolysis of the chlorine atom in presence of palladium-charcoal, (II) has yielded a base, the mono-picrate of which has been found to be different from the mono-picrate of 2-β-diethylamino (or piperidino)-ethyl-quinoline (Kermack and Muir, J. Chem. Soc., 1931, 3089).

The preliminary pharmacological examination shows that compounds of the type (I) possess antispasmodic property.

127.

K. N. S. SASTRY and S. N. MUKHERJEA, Calcutta.

Quinoline derivatives with and without 6-methoxyl groups and a few heterocyclics are known to possess antimalarial activity. With a view to prepare some Quinoline derivatives, benzyl chloride was converted into benzyl cyanide which in turn was converted into p-nitro compound m.p. 117°. This was converted into p-amino benzyl cyanide according to P. Schorr (Ber. **33**, 1900) using Sn and Hcl with a modification. Failing to give crystallisable solid in presence of Iodine and/or Hcl as catalyst, p-amino benzyl cyainide and aceto acetic ester condensed after refluxion at 170—175°, over an oil bath for three hours and yielded a white crystalline solid m.p. 220—222°. By a method similar to the conversion of benzyl cyanide into phenyl acetamide, the nitrile group of the 'anil' derivative was converted into acetamide m.p. 208—210°. Attempts at cyclisation of the 'anil' derivative being discouraging, cyclisation using medicinal paraffin at 260°, resulted in a small yield of a solid crystallised from alcohol m.p. 262°. The yield being very poor, trials are repeated.

In another experiment, phenol was converted into o-nitro phenol. This was reduced to o-amino phenol using Na_2S, which did not condense with aceto acetic ester. This work is in progress.

128. A Modification of the Method of Preparation of 5-Chloro Acridine Derivatives.

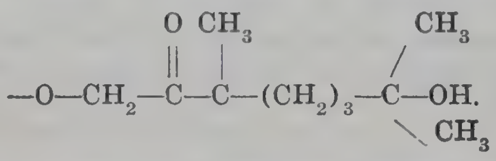
S. J. DAS-GUPTA, Calcutta.

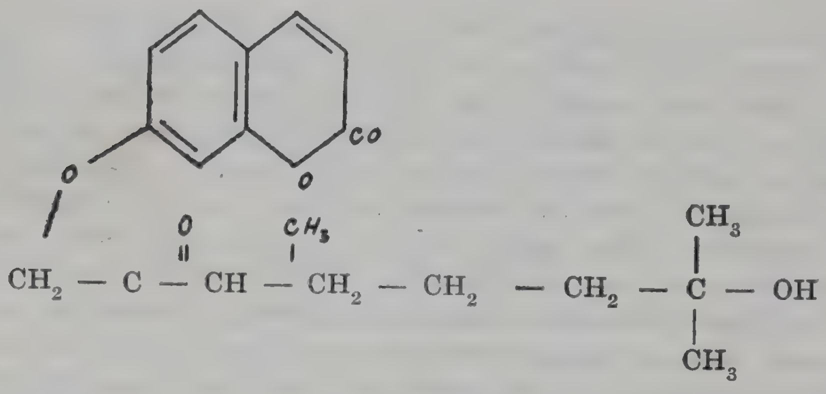
The usual process for preparing 5-chloro acridine derivatives is to prepare a diphenylamine-2-carboxylic acid and to convert it into 5-chloro acridine. Diphenylamine-2-carboxylic acids are prepared by refluxing molecular proportions of 2-chlorobenzoic acids, arylamines and anhydrous potassium carbonate in amyl alcoholic solution with a trace of copper powder. After reaction, amyl alcohol is removed by steam distillation and the residual solution gives the diphenylamine derivative on acidification. This amyl alcohol method has been modified by the author with the result that the yield has been increased from 50 p.c. to almost theoretical and the process has become less cumbrous. Equimolecular quantities of 2-chlorobenzoic acids, arylamines and anhydrous potassium carbonate (with copper powder) are melted down with the minimum quantity of phenol by heating, and the melt is kept at 130—140° for several hours. The reaction mixture on being treated with water and filtered (charcoal) gave the diphenylamine derivative on acidification.

129. On the Constitution of Marmin, a new coumarin isolated from the immatured bark of Aegle marmelos, Côrrea.

ASIMA CHATTERJEE (Nee Mookerjee) and ANIMA CHAUDHURI, Calcutta.

It was reported earlier (Chatterjee [Nee Mookerjee], Current Science, 1943, **12,** 209; Proc. Indian Science Cong., 1951, Part III, 84) that a new coumarin—marmin, $C_{19}H_{24}O_5$, m.p. 123—124° (yield, 0.03%), and alkaloid, $C_{14}H_{13}O_4N$, m.p. 176—177° (yield. 0.003%) identical with skimmianine and umbelliferone, a 7-hydroxy coumarin, $C_9H_6O_3$, m.p. 232° (yield, 0.002%) have been isolated from the immatured bark of Aegle marmelos, Côrrea.

Marmin has now been isolated in fairly good yield (0.15%) from the neutral ethereal bark extracts of A. marmelos left after the separation of skimmianine and umbelliferone by chromatography technique using alumina in column No. 4 (30 cm. × 4½ cm.). Marmin does not reduce Fehling solution and shows the presence of two double bonds on catalytic hydrogenation. It contains a carbonyl and a tertiary hydroxyl (alcoholic) groups. It is a lactone and shows negative tests for methoxy, methylene-di-oxy and phenolic groups. The function of the fifth oxygen atom has been proved to be an ether. On hydrolysis with alcoholic alkali marmin produces umbelliferone (4%) which is also obtained from marmin when it undergoes thermal decomposition on sublimation in vacuo at 180—190°/0.1 mm. On mild oxidation with chromic acid marmin produces acetone indicating the end position of the tertiary hydroxyl group in its molecule. On acid hydrolysis with sulphuric and glacial acetic acids marmin suffers fission at the ether linkage producing umbelliferone $C_9H_{16}O_3$, m.p. 232° and a ketone $C_{10}H_{20}O_3$ (b.p. 65°/0.3 mm.). The ketone contains the original tertiary hydroxyl group and another alcoholic group produced by the hydrolytic fission of the ether linkage. This ketone can reduce Fehling solution and forms an osazone, m.p. 215°, which prove the acetoin structure of the ketone, i.e., the carbonyl group in marmin is adjacent to the ether linkage. Marmin is therefore an alkyl ether of umbelliferone where the alkoxy group is  $-O-CH_2-\overset{\overset{O}{\|}}{C}-\overset{\overset{CH_3}{|}}{C}-(CH_2)_3-C(CH_3)_2-OH$. Since many natural coumarins occur as prenyl ethers it is suggested that marmin is a substituted geraniol ether of umbelliferone (I)



(I)

130. Studies on the Active principles isolated from the leaves of Aegle marmelos, Côrrea.

ASIMA CHATTERJEE (Nee Mookerjee) and SUKUMAR BOSE, Calcutta.

An alkaloid, Rutacin, $C_{14}H_{13}O_4N$, m.p. 176—177° (yield, 0.15%) and a sterol, Aegelin, $C_{18}H_{18}O_4$, m.p. 174—175° (yield, 0.09%) have been isolated from the leaves of Aegle marmelos, Côrrea. Rutacin is neutral to litmus and gives characteristic colour reactions with sulphuric acid and other alkaloidal reagents. It produces an orange red precipitate with potassium bismuth iodide and a curdy white precipitate with potassium mercuric iodide. Rutacin is a monoacidic tertiary base and forms well crystalline salts with oxalic, picric, sulphuric and nitric acids. With methyl iodide it yields an addition product, $C_{14}H_{13}O_4N$. CH_3I, m.p. 186°, dec. It produces a crystalline chloroplatinate, $(C_{14}H_{13}O_4N)_2 \cdot H_2PtCl_6$ which does not melt but decomposes above 205°. On distillation with zinc dust rutacin suffers degradation and quinoline, C_9H_7N has been isolated from the degradation products. The properties of rutacin, both physical and chemical are very similar to those of skimmianine, $C_{14}H_{13}O_4N$, m.p. 176—177°. Both of them have the same U. V. absorption spectra showing the absorption maxima at 249 m. μ, 320 m. μ and 331 m. μ and the absorption minima at 228 m. μ, 277 m. μ and 324 m. μ. Their molecular extinction is also same. Thus, rutacin is proved to be identical with skimmianine the m.p. of which is not depressed when mixed with rutacin.

Aegelin, $C_{18}H_{18}O_4$ gives positive colour tests with sterol reagents. It produces a monoacetyl derivative, $C_{20}H_{20}O_5$, m.p. 159—160°. It shows negative tests for methoxy, carbonyl, methylene dioxy and phenolic groups. On dehydrogenation with selenium aegelin suffers degradation. Studies of the degradation products are in progress the details of which will be reported elsewhere.

131. On an Alkaloid of Kopsia fruticosa—Studies on Some Degradation Products.

ANIL BHATTACHARYA, Calcutta.

It was reported earlier (J. Amer. Chem. Soc., 1949, **71,** 3370) that the alkaloid, kopsine, $C_{22}H_{26}N_2O_4$, m.p. 220° (dec.) undergoes mild hydrolysis with ammonia and produces kopsidine, $C_{20}H_{24}N_2O_3$, m.p. 142 (dec.). Kopsidine forms well crystalline picrate, m.p. 170° (dec.) oxalate, m.p. 160° (dec.) and hydrochloride which decomposes at 190° without melting. Apparently kopsidine seems to be a deacetylation product of kopsine but on acetylation it does not produce the original base and the acetylation product of kopsidine could not be crystallised.

When refluxed with alcoholic alkali (20%) kopsine suffers degradation and from the decomposition products a new base, kopsidinine, $C_{19}H_{22}N_2O_2$, m.p. 248°5 (dec.) and an acid in small quantity have been isolated. The base kopsidinine produces an orange precipitate with potassium bismuth iodide, a yellow precipitate with picric acid and a curdy white precipitate with potassium mercuric iodide. Kopsidinine shows the following colour reactions: with concentrated sulphuric acid it is colourless in the cold, pale yellow when hot and pink after 24 hours; with Erdmann's reagent it turns purple and then red; with Frohde's reagent it gives a light pink solution; with Mandelin's reagent it becomes red. Kopsidinine forms well crystalline picrate, $C_{19}H_{22}N_2O_2 \cdot C_6H_2OH(NO_2)_3$ which does not melt but decomposes at 220°. It gives a hydrochloride, $C_{19}H_{22}N_2O_2.HCl$ which decomposes at 325° without melting. Kopsidinine contains one methoxyl group. The U. V. absorption spectra of kopsidinine (absorption maxima : 247 m. μ and 302 m. μ; absorption minima : 227 m. μ and 273 m. μ is similar to that of kopsine (absorption maxima : 240 m. μ, 279 m. μ and 286 m. μ; absorption minima: 264 m. μ and 283 m. μ). Further work on kopsidinine and the acid in small quantity is in progress.

Kopsine on fusion with alkali suffers degradation. From the degradation products, skatole C_9H_9N, m.p. 92° and indole-2-carboxylic acid, $C_9H_7O_2N$, m.p. 199° have been isolated and identified. Another acid free from nitrogen, m.p. 120° has been isolated from the alkali fusion products, which is on further investigation.

132. The synthesis of some organic compounds of gold with long chain fatty acids.

NAKULESWAR KUNDU, Calcutta.

A series of higher auro-thio fatty acids was prepared with a view to examine their physiological activity. They were prepared from α-thio fatty acids which were synthesised from their α-bromo derivatives by procedures based on the methods outlined by Biilman. They are generally colourless amorphous powder insoluble in water and alcohol. In this paper, α-auro thio stearic, palmitic, myristic and lauric acids have been described. These compounds may effectively be used in an oil suspension for the treatment of tuberculosis, arthritis etc.

133. Alkaloids of Glycosmis arborea Correa.

R. N. CHAKRAVARTI and S. C. CHAKRAVARTI, Calcutta.

Work has been taken up on the constitution of arborine, m.p. 155—156°, and arborinine, m.p. 175—176°, the two alkaloids isolated from Glycosmis arborea Correa by the present authors (Cf. Proc. 38th Ind. Sc. Cong.: Part III: Abstracts, p. 79). Arborine has got the molecular formula $C_{31}H_{26}O_2N_4$, is a ditertiary base and contains one N-methyl group. Arborinine is an extremely weak tertiary base having the molecular formula $C_{26}H_{24}O_6N_2$. It contains two methoxy and two N-methyl groups. Both arborine and arborinine do not show any optical activity.

On distillation with sodalime, arborine gives methylaniline and toluene with copious evolution of ammonia. Arborine is stable to boiling concentrated hydrochloric acid but is hydrolysed by alkalies to N-methyl-anthranilamide, N-methylanthranilic acid, phenyl acetic acid and a weak acid, $C_{15}H_{11}O_2N$, m.p. 221—222°, with evolution of ammonia. On complete hydrolysis by prolonged heating with alkalies one molecule of arborine appears to give one molecule of N-methylanthranilic acid, one molecule of phenylacetic acid, one moelcule of the weak acid $C_{15}H_{11}O_2N$ and two molecules of ammonia.

$$C_{31}H_{26}O_2N_4 + 4H_2O = C_8H_9O_2N + C_8H_8O_2 + C_{15}H_{11}O_2N + 2NH_3$$

Reduction with zinc and dilute hydrochloric acid furnishes tetrahydroarborine, $C_{31}H_{30}O_2N_4$, m.p. 199—200°, in extremely poor yield. This product can, however, be obtained in quantitative yield by the catalytic hydrogenation of arborine. Unlike arborine, tetrahydroarborine is stable to alkalies but is readily hydrolysed by hot dilute acids. In addition to N-methylanthranilamide and N-methylanthranilic acid it gives phenylacetaldehyde under these conditions.

134. Transformation of Biguanide into Dicyandiamidines.

NAKULESWAR KUNDU and PRIYADARANJAN RAY, Calcutta.

An acid solution of the N^1-p-sulphonamido phenyl biguanide hydrochloride has been found, on keeping overnight at the ordinary temperature, to deposit wooly crystals of a sparingly soluble substance, which gave no characteristic test with copper and nickel salts either for biguanide or dicyandiamidine. The constitution of ahe changed product was studied and proved, by analysis as well as by its direct synthesis, to be identical with the isomeric dicyandiamidine with carbonyl adjacent to the aryl substitution.

A number of isomeric dicyandiamidines were prepared by various methods and their properties studied. From the results it has been concluded that all dicyandiamidines with carbonyl adjacent to an aryl group give no reaction with copper and nickel salts, while those with carbonyl farther from the aryl or beside an alkyl group give this reaction as usual.

Of the various biguanides described, it was observed that only those with sulphanilamide or substituted sulphanilamide at N^1-position undergo rapid hydrolysis in acid solution into the corresponding isomeric dicyandiamidine, which is however inhibited by its alkyl or aryl substitution at N^5-atom of the biguanide molecule.

A study of the specific reaction rate of the p-sulphonamido phenyl biguanide in acid solution at two different temperatures has been made which shows the reaction to be a unimolecular one with $k_{32} = 8.98 \times 10^{-7}$, $k_{46} = 2.83 \times 10^{-6}$/sec. From this the energy of activation E has been calculated to be equal to 15,850 cals/mole and the value of Arrhenius constant InA = 12.26.

135. Andrographolide, the Active Constituent of Andrographis paniculata Nees (Kalmegh).

Mrs. D. CHAKRAVARTI and R. N. CHAKRAVARTI, Calcutta.

It was observed by Gorter (1911) that andrographolide is a trihydroxy lactone, with one tertiary hydroxy group, having the molecular formula, $C_{20}H_{30}O_5$. It was later reported by Guha Sircar and Moktader (1939) that andrographolide contains a methylene group and a hydroxy group instead of three hydroxy groups as found by Gorter. In a paper submitted to the Indian Science Congress last year (cf. Proc. 38th Ind. Sc. Cong.: Part III: Abstracts, p. 79) the present authors established that andrographolide is a trihydroxy lactone with a tertiary hydroxy group and does not contain any methylenedioxy group. It was also stated by the present authors that andrographolide is an $\alpha : \beta$ -unsaturated lactone, as found out by U. V. absorption spectra and a positive Legal test, with two double bonds and a methylene group attached to a double bond as found out by the formation of formaldehyde during ozonolysis. More recently it has been observed by the present authors that andrographolide yields polyalkylated naphthalenes on dehydrogenation with selenium indicating that andrographolide contains a reduced naphthalene skeleton.

The results as quoted above from the previous publicatoin by the present authors (loc. cit.) have since been confirmed by Schwyzer, Biswas and Karrer (Helv. Chim. Acta, 1951, **34**, 652). Unfortunately, however, no reference has been made in this paper about the results recorded by the present authors in the 1951 Abstracts of the Indian Science Congress (loc. cit.) although this Abstract was distributed a month before the paper by Karrer et al. was communicated and reached at least one of the authors (H. G. Biswas) in proper time.

136. Investigation on the Reduction of aromatic Nitro compounds.

H. G. BISWAS, Calcutta.

A method for the reduction of aromatic nitro compounds with the help of metal powders and soluble inorganic sulphates and nitrates have been tried for the first time. An interesting fact has been observed that soluble chlorides give the best yield of the amino compound, then come sulphates and the least satisfactory are the soluble nitrates, irrespective of the metal powder used. Work on the mechanism of reaction and further details of the process is in progress.

137. Studies on Vitamin A in Solution: Aqueous System.

SUKHAMOY BHATTACHARYA and U. P. BASU, Calcutta.

The vitamin A generally used for medicinal purpose is often dispersed in oily menstrum but it is being recently reported (Esh and Bhattacharya, Indian J. Physiol. Alli. Sci., 1951, **5**, 15; Sobel et al, Federation Proc., 1949 (March), **8**, No. 1; Am. J. Dis. Child., 1947. **73,** 543; 1949, **77,** 576) that a better utilization is effected if it be dispersed in an aqueous phase.

Studies on Vitamin A in vitro show that vitamin A in the form of alcohol or acetate, when dispersed in aqueous medium with polyoxyehtylene sorbitan monolaurate, commercially known as Tween 20, behaves in a different way from that when dissolved in glycerides or esters. Vitamin A acetate which is more stable in oils and esters is less stable than the alcohol when dispersed in aqueous menstrum.

The pH of the aqueous solution determines the stability of vitamis A irrespective of its chemical form. It is more stable at pH of about 6.0 than at pH 3.0. The hydroxyantioxidant, propyl gallate, having a concentratios of 0.075% does not show any antioxygenic property in keeping the vitamin A potency in aqueous medium.

138. Dealkylation of Brucine.

BALDEV SINGH and S. H. ZAHEER, Hyderabad-Dn.

Dealkylation of brucine has been attempted with a view to preparing substances of greater physiological activity. Brucine forms almost fifty per cent. of the total alkaloids of Nux vomica and occurs along with the medicinally important alkaloid strychnine. In pysiological activity it is nine times less effective than strychnine.

According to the latest studies in the structure of strychnine and brucine, the latter has two methoxy-groups in ortho position more than the former; the rest of the structure being identical. Two methods of demethylation have been tried and two crystalline substances obtained, m.238°C and 278—284°C. Work on the identification and physiological action of these substances is in progress.

139. Syntheses of Quinazolinols.

I. K. KACKER and S. H. ZAHEER, Hyderabad-Dn.

In continuation of the work reported earlier (Proc. Indian Sc. Cong. Assoc., 1951, III, pp. 66-67), some substituted 4-quinazolones (1 mole) were reacted with phenylmagnesiumbromide (2 moles) with a view to get corresponding substituted 4-quinazolinols which are expected to possess analgestic activity. In each reaction a colourless crystalline product was isolated as quinazolinol though in poor yields as quite a good amount of the reaction mass was left over as an uncrysatllisable semi-solid mass. This residue in the preparation of 2-ethyl-3-p-tolyl-4-quinazolinol on distillation under reduced pressure not only gives a new liquid product which solidifies on cooling but also some more of the same solid product obtained from the residue left over in the claisen flask. A small quantity of diphenyl as well as original quinazolone is also obtained. The results of the work are as below;

	Reactants.	**Products.**
1.	2 — ethyl — 3 — phenyl — 4 — quinazoline and C_6H_5MgBr.	2—ethyl— 3 —phenyl— 4 —quinazolinol mp. 156—57°C, yield 46%; and an uncrystallisable semi-solid residue.
2.	2 — ethyl — 3 — p-tolyl — 4 — quinazoline and C_6H_5MgBr.	2—ethyl— 3 —p—tolyl— 4 —quinazolinol mp. 154—55°C, yield 48% (1st crop) 24% (2nd crop) ; a colourless liquid bp. 71—72°C/2.3 mm., mp. 40—41° yield 18%; a little of diphenyl and a little of original quinazolone.
3.	2—n-propyl— 3 —phenyl— 4 —quinazoline and C_6H_5MgBr.	2—n—propyl— 3 —phenyl— 4 —quinazolinol mp. 154—55°C, yield 37% ; and an uncrystallisable semi-solid residue.
4.	2—n-propyl— 3 —p-tolyl— 4 —quinazoline and C_6H_5MgBr.	2—n—propyl— 3 —p—tolyl— 4 —quinazolinol mp. 151—52°C, yield 40% ; and an uncrystallisable semi-solid residue.

Further work on the identification of the new by-product obtained in 2 and careful working of the semi-solid residues in 1, 3 and 4 is in progress.

140. Production of Levulinic acid from molasses.

N. SHANMUKHA RAO and K. RAMACHANDRAN, Hyderabad-Deccan.

In continuation of last year's communication (Proc. 38th Ind. Sc. Cong., Part III, Abstracts, p. 102) where the method of preparing levulinic acid and its calcium salt were described, this paper describes three other methods of isolating the levulinic acid from the dark reaction mixture. While ether extraction was very satisfactory in the laboratory experiments it has inherent difficulties in its application on a large scale. Esterification procedures did not give uniformly good yields. The method finally adopted is that of direct vacuum distillation, after removal of the humus material by filtration, the hydrochloric acid by distillation at atmosphehic pressure and filtration of any inorganic precipitates which separate while concentrating further on the steam bath. Very pure levulinic acid is obtained by a second vacuum distillation.

141. Note on the preparation of Vanillin from alkali lignin.

V. D. N. SHASTRI and S. H. ZAHEER, Hyderabad-Dn.

In continuation of the work on the isolation of alkali lignin from the black liquor from the Sirpur Paper Mills, reported from these laboratories (G. S. Shenolikar and S. H. Zaheer, proceedings of the Indian Science Congress, 1951, Chemistry Section), the Possibility of Utilizing this Lignin material, especially for purposes of making vanillin, is being explored.

The method of Freudenberg, i.e., treatment of the ligning material with nitrobenzene and alkali at elevated temperatures (Ber., 1940, **73,** 167) has been employed. The yield of vanillin, under the conditions employed, is not of the same order as that from sulphite black liquor, reported by previous workers.

However, with some suitable modifications in the conditions of oxidation, the yield of vanillin may appreciably increase. Further work in this direction is in progress.

142. Recovery of Naphthalene from Creosote oil Sediment.

BHARAT BHUSHAN, Hyderabad-Deccan.

Creosote oil on cooling (for example, in severe winters) yields a dark brown paste as sediment (0.5 to 5.0 %) which contained 50 to 75% naphthalene. Since the oil and the naphthalene boiled in the same range (210—240°C.), the latter could not be recovered by sublimation. Various attempts to separate the oil by emulsification, sulphonation, etc. having failed, the following procedure was successfully worked out: One ton of sediment was centrifuged yielding 48.5 gallons of creosote oil and the 1800 ℔s. brownish residue. The latter was charged into a three-ton distillation still. The pale distillate which solidified on cooling was found to contain 2.0 % oil. The solid was again charged into the centrifuge basket and given a successive washwith small quantities of kerosene oil and petrol. The colourless naphthalene (1637 ℔s. 73.08 %) was found to be free from oil and could be used as laundry moth-repellent. If desired, the product could be further purified by sublimation.

143. Condensation of Chloroacetone with Phenol and its Ethers.

P. M. BHARGAVA and S. HUSAIN ZAHEER, Hyderabad-Dn.

Chloroacetone (1 mol.) has been condensed with phenol (2 mols.) in presence of concentrated sulphuric acid (1 mol.) to yield 1, 2, 2-tris (*p*-hydroxyphenyl) propane (I), m.p. 179° (cf. Lippmann, Ber., 1912, **45,** 2489); conditions for an optimum yield (70.3%) of the product I have been worked out. I has been characterised by the preparation of the following esters and ethers, the former having been obtained by reacting with the corresponding acid chloride in presence of pyridine, and the latter by reacting with the corresponding alkyl iodide in acetone solution and anhydrous potassium carbonate: triacetate, m.p. 123—124°; tripropionate, m.p. 107—108°; trimethyl ether (II), m.p. 124°; triethyl ether (III), m.p. 105—106°; tri-*n*-propyl ether, m.p. 107—108°; triallyl ether, m.p. 94—95°; II and III have also been obtained in good yields, by the condensation of chloroacetone with anisole and phenetole respectively.

144. Chlorination of Ricinoleic acid and its Methyl ester.

S. VENKOB RAO, K. T. ACHAYA and S. A. SALETORE, Hyderabad-Deccan.

Chlorination of pure ricinoleic acid and methyl ricinoleate in carbon tetrachloride was conducted at room and ice temperatures using chlorine gas. Saturation is rapidly attained with production of heat, and further passage of chlorine leads to increasing molecular weight and refractive index, shewing either substitution or polymerization, probably the latter. Alcoholic potash effected removal of chlorine creating unsaturated acids. Low temperature chlorination for a short time gave substantially a dichloro-product, though some replacement of hydroxyl by chlorine was indicated by the acetyl values.

Chlorination of methyl ricinoleate again indicated that additive saturation occurred rapidly and that part of the hydroxyl was also easily replaced to give trichloro-products. The evidence appeared to show that chlorine commenced to replace hydrogen in the carbon chain even after only small amounts of hydroxyl had been replaced. Selectivity in chlorination, if any, is being studied under different conditions.

145. Studies on Annona squamosa (Linn.) seed (sitaphal), Part II: Its toxic principle.

N. BHOJRAJ NAIDU, BOHAN BABU NAIDU and S. A. SALETORE, Hyderabad-Dn.

With a view to study the toxic principle in sitaphal seed, its decorticated meal was extracted with cold 95% alcohol, and the extract successfully resolved into sugars, an acidic fraction and oil containing dissolved in it the toxic matter. This toxic product was separated from the oil by dissolving in a large volume of low boiling petrol ether and cooling to 5°C for 2 days and further purified by repeated precipitation from ether solution by means of petrol ether, to give a dark brown viscous semi-solid mass, in an yield of 1% on the weight of the seed.

On analysis the toxic concentrate was found to have a high molecular weight, 560.7, low iodine value, 32.1 and about 2 hydroxyl groups per molecule. Tested against aphids and pumpkin bettles, it was found to have a toxicity eight times that of the seed oil and six times that of D.D.T.

The acids obtained (96.5%) on saponification of same and the non-saponifiable portion (3.5%) were both free from toxicity.

Further work is in progress.

146.Condensation of Methyl Acrylate with β -Phenylethyl Amine.

PADMINI SONI and G. S. SIDHU, Hyderabad-Dn.

Methyl acrylate has been condensed with β-phenylethyl amine. When condensation is effected by allowing two moles of the ester to stand with one mole of the amine in absolute ethyl alcoholic solution for four days at room temperature, the products are:

(i) 2-carbomethoxyethyl 2′-phenylethyl amine and } separated by distillation
(ii) bis (2-carbomethoxyethyl) 2′-phenylethyl amine } under reduced pressure.

When the condensation is brought about in the absence of any solvent and after four days standing the reaction mixture is warmed on a boiling waterbath for fifteen minutes (ii) is formed almost to the entire exclusion of (i). Crystalline hydrochlorides have also been prepared in both cases.

147. The preparation of ricinoleic and oleic acids by simple techniques.

K. T. ACHAYA and S. A. SALETORE, Hyderabad-Deccan.

Methods for the preparation of pure acids generally involve complex procedures like crystallisation of salts, fractional distillation, low-temperature crystallisation, bromination and debromination, etc., often not possible or easy to accomplish. Using fractional extraction of castor oil, concentrates of triricinolein and thence of ricinoleic acid, have been obtained in apparently over 98% purity. The nature of the product and its impurities, mainly dihydroxystearic and saturated acids, is described.

Conditions have been worked out for the isolation from groundnut oil of 'oleic acid' of iodine value 92 (theory 90.1) in 50% yield by the judicious use of simple methods involving urea complexes.

148. Synthesis of some Hydroxy—Ketones.

A. B. SEN and T. N. KAKAJI, Lucknow.

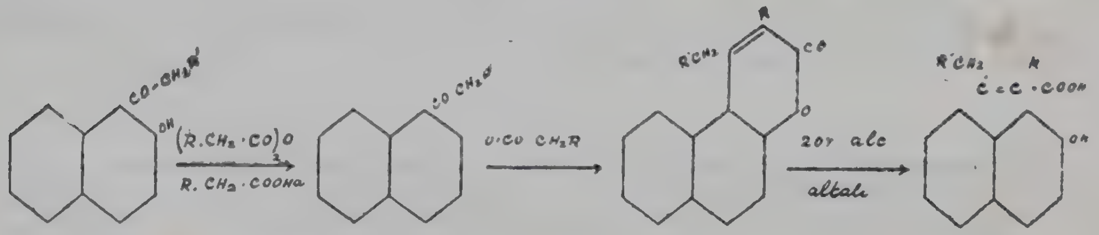
With a view to study Kostanecki acylations and to find out whether the substitution in para-position to the hydroxyl group had any influence in the formation of coumarins and chromones, the following ketones have been prepared by the Fries' migration of the appropriate esters of p—tertiarybutyl and amyl phenols. The results are summarised in the following table:—

No.	Ketones.	B.P.	M.P. of 2:4—dinitrophenylhydrazone.
1.	5 —tert—butyl— 2 —hydroxy— acetophenone	130°/12 mm.	170°
2.	— do — propiophenone	165°/26 mm.	164°
3.	— do — butyrophenone	150°/20 mm.	176°
4.	5 —tert—amyl— 2 —hydroxy— acetophenone	165°/20 mm.	185°
5.	— do — propiophenone	110°/30 mm.	156°
6.	— do — butyrophenone	170°/20 mm.	186°

149. Kostanecki Acylation—Part I. Studies in the 1—acyl—2—naphthol Series.

A. B. SEN and T. N. KAKAJI, Lucknow.

Kostanecki acylation has been studied with 1—acyl—2—naphthols. 1—acetyl, 1—propionyl—and 1—butyryl—2—naphthols were condensed with acetic, propionic and butyric anhydrides. In all the cases, naphtho-coumarins (II) were formed as determined by the results of hydrolysis with 2N alcoholic alkali. The reactions are given by the following equations:—



I
1acyl-2 naphthols

II
naphthocoumanius

III
naphtnocoumanic acid

The results are summarised in the following table:—

Naphtho-coumarins (II)

R=	R′=	m.p.
1. CH_3	H	97°C.
2. C_2H_5	H	60°C.
3. H	CH_3	59°C.
4. CH_3	CH_3	46°C.
5. C_2H_5	CH_3	72°C.
6. H	C_2H_5	119—20°C.
7. CH_3	C_2H_5	82°C.
8. C_2H_5	C_2H_5	94°C.

150. Preparation of Dyes from meta—and para—Aminoacetophenones.

A. B. SEN and R. C. SHARMA.

Thirty oil soluble azo dyes have been prepared from meta—and para—aminoacetophenones (fifteen from each) by coupling the diazotised amines with the following phenols. These dyes have been characterised through their acetates.

PHENOLS USED:

Phenol, o—and p—Chlorophenols, 2, 4 dichlorophenol, o—and m—Cresols, m—Ethylphenol, Ethyl methyl phenol, o—and m—Nitrophenols, Salicylaldehyde, Resorcinol, o—and p—Hydroxy diphenyl, p—tert. Butyl and amyl phenols, and Xylenols.

151. Studies on the Solubility and Light-fastness of Azo-dyes. (Part II).

A. B. SEN and R. C. SHARMA.

The solubility of eight azo dyes of benzene—azo—phenol series containing —Cl, —CH_3, —C_2H_5, —OH, —CHO and —COOH groups in different positions of the phenolic part has been determined in benzene, alcohol and ground nut oil. The stability of these dyes towards sunlight has also been studied by the help of a photoelectric colorimeter. Groups like —Cl, —C_2H_5, —CH_3, and —CHO increase the solubility in benzene and oil whereas —OH and —COOH groups retard it. Excluding the dye containing a —C_2H_5 group, the converse is true in the case of alcohol. Dye containing —C_2H_5 group in para position has been found to be most suitable as its solubility in the above solvents is very high and the fading rate is also comparitively very low.

152. Organic Fungicides: Part V. Fungicidal Activity of some Dibromoacetamides.

A. B. SEN and K. C. JOSHI, Lucknow.

The synthesis of a number of dibromoacetamides has been described by the authors in an earlier paper of this series. (Jour. Ind. Chem. Soc., 1948, **25**, 483). This paper incorporates the results of the investigation of the fungicidal activity of these dibromoacetamides on Aspergillus Niger, employing the Ager Growth method. As expected, the following six compounds, were found to be considerably toxic to the fungi,

		Percentage Inhibition (average) after 96 hrs. Concentration used.		
No.	Name of compound.	1:10,000.	1:100,000.	1:1,000,000.
I.	N—Methyl dibromoacetamide	47.9 %	34.3 %	25.6 %
II.	N—Ethyl dibromoacetamide	39.8 %	29.6 %	25.2 %
III.	N—n—Butyl dibromoacetamide	16.2 %	9.9 %	3.8 %
IV.	N—Diethyl dibromoacetamide	24.8 %	19.5 %	7.9 %
V.	N—Dibromoacetanilide	45.9 %	32.9 %	18.8 %
VI.	N — Dibromoacetyl — phenyl — hydrazine	23.5 %	16.3 %	5.5 %

153. Fungicidal Activity of some esters of Cresotinic Esters. Organic Fungicides: Part VI.

A. B. SEN and K. C. JOSHI, Lucknow.

The preparation of a number of esters and ether-esters of cresotinic acids has been reported by the authors in an earlier paper of this series. (Jour. Ind. Chem. Soc., 1949, **26**, 335). In this paper, the fungicidal activity of the esters has been evaluated by the Agar Growth method. The growth of Aspergillus Niger was inhibited to various extent by different esters, the Percentage Inhibition ranging from 20.5% to 39.2% at a concentration of 1:10,000 after 96 hrs.

154. Chemotherapy in Tuberculosis Preparation of Acyl-Diphenylyl-Amidines. Part I.

M. P. KHARE and V. S. MISRA, Lucknow.

It is well known that any potent anti-tubercular compound should have good lipoid solubility and large surface area along with being basic in nature. Keeping these observations in mind, work has been undertaken to synthesise acyl-diphenylyl-amidines with a view to test their activity against Mycobacterium-tuberculosis.

4′—aceto—N—4—diphenylyl—benzamidine, the first in the series has been prepared in good yields by following the general method of Bauer and Cymerman (J. C.S. 1950, 1826). 4—amino—diphenyl was acetylated and then converted into 4′—aceto—4—amino—biphenyl by Friedel and Crafts method, thus introducing CH_3—CO—a lipoid soluble group. This compound, after deacetylation, was converted into its benzene-sulphonate and then fused with phenyl-cyanide at 225°C for 4½ hours. The above amidine was obtained as a pale yellow powder m.p. 228°—230°C. Other amidines from substituted benzonitriles are being prepared.

155. Isoflavones. Part I. Some nitro Isoflavones.

N. L. DUTTA and J. L. BOSE, Poona.

Work has recently been carried out on the synthesis of 4—hydroxy—quinoldino— α —pyrones and quinolyl—coumarins as intermediates in the synthesis of some potential anti-malarials of alkylaminoquinolines type containing the α—pyrone ring. Similar compounds containing the γ —pyrone ring namely 4—hydroxy quinolyl α—chromones, have not been synthesised so far.

The present paper reports the synthesis of some nitro-isoflavones having the nitro group in the 3—phenyl nucleus which would be required as intermediate in the above synthesis. 7—Hydroxy 4′—nitro or 5, 7—dihydroxy—4′—nitro isoflavones have been synthesised using the ethyl orthoformate condensation method from the corresponding nitro-deoxybenzoine. The latter were obtained in improved yields and were also converted to the corresponding nitro—2—methyl isoflavones by drastic acetylation. A new crystalline compound, m.p. 261—62°C was obtained in the course of an attempt to modify the ethyl orthoformate condensation method in the case of 2, 4, 6—trihydroxyphenyl 4—nitro benzyl ketone. The nature of the compound is under investigation.

156. Nitration of benzo— γ —pyrone.

T. R. INGLE and B. V. BHIDE, Poona.

Reference to the literature revealed that very few attempts have been made to study the nitration of chromone derivatives. This communication, therefore, deals with the nitration of simple chromone.

Benzo— γ—pyrone i.e. chromone (M.P. 57°C) was nitrated by nitric acid and sulphuric acid mixture at 0°C, when it yielded a nitro derivative, M.P. 171°C. This nitro chromone on hydrolysis by dilute sodium hydroxide gave a ketone, M.P. 99—100°C, identical with 3—nitro 2 hydroxy acetophenone. (Wittig A. **446**, 181). This nitro chromone on reduction with iron filings and dilute hydrochloric acid gave the corresponding amino chromone, M.P. 204—205°C.

157. The structure of the gum from Drum-stick plant, i.e., Moringa Pterygosperma. (N. O. Moringeae). Part I. Chemical investigation of the gum.

T. R. INGLE and B. V. BHIDE, Poona.

The purified gum from the Drum-stick plant (Moringa Pterygosperma) has been analysed by the standard methods, and found to possess the following composition. Pentoses 50.2%, Methyl pentoses 0.5%, Cellulose 5.3%, hexouronic acid 11.9%, Ash 0.3%, and hexoses (by difference) 31.8%. The analysis of the ash indicated the presence of Fe, Mg and CO_3.

The partial hydrolysis of the gum by 3% as well as 10% sulphuric acid gave a mixture of an acid polysaccharide and a syrup containing non-acidic reducing sugars. From the syrup galactose and arabinose were obtained in the crystalline condition, while it was observed that rhamnose might be present in traces. The acid polysaccharide, by hydrolysis of its barium salt as well as by the percentage of Barium found as barium suphate, was found to be a trisaccharide consisting of two units of galactose and one unit of glucoronic acid.

Further work about the constitution of this acid is in progress.

158. Investigation of the mucilage from Talimkhana. (N.O. Asteracantha Longifolia).

T. R. INGLE and B. V. BHIDE, Poona.

This spiny bush is common throughout India, Ceylon Tropical and South Africa. Almost all of its parts are used for medicinal purpose. The seeds of this plant are an article of commerce in Indian market. The seeds are generally called as Talimkhana, while the bush is commonly known as Kolshinda. The seeds contain nearly 10 per cent. mucilage. It can be removed from the seeds by keeping the seeds in water for a few hours and fitering it through cloth by pressing or any other mechanical means. When the mucilage was observed under the microscope, it was found that it had a well defined structure. It was composed of cellulose fibres arranged in ladder like pattern, and the inner space being filled with a mucilaginous material.

On obtaining the mucilage from the seeds by 2 per cent. sodium hydroxide and precipitating it by acidified ethanol, the powder was hydrolysed by 10 per cent. sulphuric acid. After working it in the usual way it gave a syrup containing non-acidic reducing sugars and a negligible quantity of the barium salt of acid polysaccharic. From the sugar syrup, xylose was obtained in the pure crystalline form.

Further work is in progress.

159. The structure of the mucilage from the seeds of Tulsi. (N.O. Ocimum Sanctum Linn). Part I. Study of products of hydrolysis.

T. R. INGLE and B. V. BHIDE, Poona.

The mucilage was extracted from the seeds of Tulsi plant (N.O. Ocimum Sanctum Linn.) by 2% sodium hydroxide and was precipitated as a white powder by acidified ethanol. The routine analysis of the mucilage indicated the following composition. Hexouronic acid 27.2%; Pentoses 38.9%; ash 0.2%. The ash on analysis gave the tests for Fe, K, Cl, CO_3.

The mucilage could not be hydrolysed by 3% sulphuric acid. On hydrolysing it by 10% sulphuric acid, the barium salt of the acid polysaccharide and a syrup containing non-acidic reducing sugars were obtained. On analysing the syrup by paper chromatogram as well as estimating the pentoses by the standard method, it was found that it contained only one sugar, Xylose. It was, then, obtained in pure crystalline form.

The analysis of the barium salt of the acid polysaccharide indicated that it was a trisaccharide. Its oxidation by nitric acid did not give mucic acid; but on the other hand the well defined characteristic crystals of potassium saccharate were obtained by working out the oxidised mixture. Hydrolysis of the barium salt by 5% sulphuric acid gave further quantity of xylose. These results indicate that the trisaccharide might be composed of two xylose units and one glucoronic acid unit.

Further work is in progress.

160. Shellac—Aniline—Formaldehyde Moulding Powder.

A. N. DHAR, Patna.

Due to good electrical and Mechanical preperties Aniline-Formaldehyde plastics are getting very popular in foreign countries specially in the field of radio and Television industries. They have at times been used to replace mica, ceramics, phenolics and polystyrenes.

Different proportions of Shellac, aniline and para formaldehyde have been reacted to yield moulding powders. 3 times or less shellac on the Wt. of Aniline used give molding powders with good properties.

Further studies on the preparation of improved types of Molding compositions are now in progress.

161. Methylation of Shellac.

A. N. DHAR, Patna.

Aqueous alkaline solns. of Shellac have been reacted with the requisite quantity of Dimethyl sulfate at ordinary temp. The product viscous, non-sticky, non-resinous yellow liquid obtained differs fundamentally with shellac, giving definite indication of changes in the structure of shellac resin.

The characteristic changes brought about by such a reaction are:—

(1) A viscous, yellow liquid Product.

(2) Acid value very low.

(3) Soluble in Toluene and partly in Benzene.

Detailed studies on the technique of Methylating Shellac and the properties of the products obtained, there by are in progress.

162. Synthesis of Anthocyanidin Pigments.

P. SARADAMMA and T. PANKAJAKSHI AMMA, Trivandrum.

7—O—Benzoyl Fisetinidin chloride was synthesised by condensing together O—Benzoyl Resorcyl aldehyde and w. 3:4—trihydroxyacetophenone in a mixture of absolute alcohol and dry ethyl acetate in the presence of dry Hcl at 0—2°C. The pure salt crystallised out in glistening, hexagonal, reddish brown needles (under the microscope) with a violet sheen. A study of its reactions with ordinary reagents shows that it closely resembles Fisetinidin chloride having an acyl group in its molecule. It decomposes at 200°C.

163. Purified Oil of Calophyllum Inophyllum (Linn.).

K. G. DAS and P. P. PILLAY, Trivendrum.

After the removal of the Resin from the oil by shaking out with either alkali or alcohol the oil is obtained in a colourless non-odorous condition and has the following constants.

Constants.

1. Specific gravity 0.907 at 26°C.
2. Solidifying point 4°C.
3. Melting Point 8°C.
4. Refractive index 1.4659 at 30°C.
5. Saponification value 212.
6. Iodine value 86.

By the usual methods it was found to contain the following acids: Stearic, Palmitic, Oleic, Linoleic and Erucic. A higher melting fatty acid is present in this which is being investigated.

164. Zirconium tetrachloride in Organic Synthesis.

P. T. JOSEPH, Trivandrum.

An hydrous Zirconium tetra chloride can be prepared from zircon separated from the beach sands of Travancore. This zirconium tetra chloride forms a zirconium complex with benzoyl chloride. This complex can be condensed with naphthalene and benzene to prepare I benzoyl naphthalene and benzephenone respectively. Zirconium tetrachloride can thus be used in the Perrier Procedure for preparing ketones in very good yield.

165. Isolation of Crystalline non-typical constituents from the fixed oil of Calophyllum Inophyllum (Linn.).

K. G. DAS and P. P. PILLAY, Trivendrum.

The green bad smelling oil (50% of the kernel) is a reputed remedy as an external application in rheumatism, leprosy and skin diseases. Alcohol removed from it the non-typical constituents as a viscous greenish residue (15-23% of oil), the so-called 'resin' of Punna oil. From this was isolated, by three different methods of separation, three very interesting crystalline polycyclic acids belonging to a new series to be found in fixed oils.

1. An unsaturated Keto-acid.

Yellow needles from acetone, melting at 220°C, Eq. wt. 351; Mol. wt. 352 (Rast) contain four double bonds. Ammonium salt M.P. 196—198°C, Silver salt M.P. 174°C, Acetyl derivative M.P. 238°C, Methyl ester M.P. 230°C, Hydrogenated product M.P. 232°C, Semicarbazone M.P. 264°C, Phenyl hydrazone M.P. 268°C, Nitroderivative M.P. 145°C.

2. A saturated Keto-acid.

Colourless plates from benzene, melting at 175°C, Eq. wt. 365, Mol. wt. 365 (Rast), Silver salt M.P. 212°C, Methyl ester M.P. 130°C, Semicarbazone M.P. 256°C, Magnesium salt M.P. 202—204°C.

3. Acid M.P. 140°C.

Giving a very beautiful and intense blue colouration with ferric chloride. Eq. wt. 452, Mol. wt. 446.7 (Rast), 454 (Silver salt method), Ammonium salt M.P. 166—168°C, Potassium salt M.P. 290—292°C, Silver salt M.P. 192°C, Methyl ester M.P. 164°C, Acetyl derivative M.P. 280—282°C, Hydrogenated product M.P. 196°C. Contains four double bonds.

Two neutral products also were isolated.

1. Yellow crystalline spangles from alcohol M.P. 154°C.
2. Substance crystallising the rhombic form from alcohol M.P. 196°C.

Further work is in progress.

167. Fatty acids present in the resin on the fixed oil of calophyllum inophyllum (Linn.).

K. G. DAS and P. P. PILLAY, Trivendrum.

Along with the non-typical constituents were found free fatty acids in the Resin of the fixed oil of calophyllum inophyllum. By separation in the usual manner it was found to contain the following acids: Stearic, Palmitic and Oleic.

A higher melting acid of the fatty series is also present which is being investigated.

168. Chemical examination of the Roots of Chonemorpha Macrophylla (G. Don.).

K. G. Dass and P. P. PILLAY, and N. THANUKRIṢHNAN, Trivendrum.

The root bark of chonemarpha macrophylla a large climbing shrub with milky juice belonging to the natural order Apocynaceae, has been shown to contain a quarternary high melting alkaloid of the formula $C_{11} H_{23} NO_3, H_2 O$ melting point at 416°C obtainable in an yield of 3.03%. The pure alkaloid melts with decomposition into two simpler compounds at 416°C. The chloride, bromide, iodide, sulphate, tartrate, picrate and chloroplatinate of this alkaloid have been prepared in crystalline condition and analysed. Besides it has been shown to contain carbonyl group and pentavalent nitrogen with a quarternary hydroxy group. Further work is in progress.

169. Biguanides as Potential Antimalarials.

H. L. BAMI and M. S. CHADHA,Delhi.

During the course of systematic work on biguanide derivatives as possible antimalarials it was observed that biguanide molecule substituted with an aryl group at N^1—position and a simple alkyl group at N^5—position offer the most active antimalarials, (Curd and Rost J. Chem. Soc., 1946, 729, Jaswant Singh et al, Indian J. Malariology 1949, **3**, 405, 1950, **4**, 455, Bami and Guha, Current Science 1948 **17**, 272).

In order to improve the solubility and perhaps the activity of this type of compounds, it was decided to introduce a carboxyl radical in the N^5—alkyl group which could be done by condensing an arylcyanoguanidine with simple amino-acids. Consequently N^1—phenyl—N^5—aceto biguanide hydrochloride and its p—chloro, p—bromo, p—iodo, p—methyl, and p—ethoxy phenyl analogues were prepared by condensing the corresponding arylcyanoguanidines with glycine hydrochloride in nitrobenzene. One of these compounds viz., N^1—p—chlorophenyl—N^5—aceto biguanide hydrochloride (m.p. 248°C) was tested against P. knowlesi infection in S. rhesus monkeys and was found to be effective at a dosage of 10 mg/kg b.w per day.

Problem is being further investigated.

170. (1) 2— Arylimino— 3 —aryl— 4 —keto—tetrahydrothiazoles.

PRITHWI NATH BHARGAVA.

A number of thiazoles have been synthesised by condensation of S—diaryl thioureas with monochloroacetic acid (Pro. Ind. Sc. Cong. Chem. Sec. Abst., 78, 1949) and their respective semicarbazones have been obtained. The formation of semicarbazones gives evidence regarding the presence of a keto group in the tetrahydrothiazoles.

Thus 2—phenylimino—3—phenyl—4—keto—tetrahydrothiazole, m.p. 176°, semicarbazone, m.p. 194°; 2—o—tolylimino—3—o—tolyl—4—keto—tetrahydrothiazole, m.p. 155°, semicarbazone, m.p. 182° 2—p—tolylimino—3—p—tolyl—4—keto—tetrahydrothiazole, m.p. 128°, semicarbazone, m.p. 152°; 2— α —naphthylimino—3— α —naphthyl—4—keto—tetrahydrothiazole, m.p. 173°, semicarbazone, m.p. 186°; 2— β —naphthylimino—3— β —naphthyl—4—keto—tetrahydrothiazole, m.p. 193°, semicarbazone, m.p. 208°; 2—p—anisylimino—3—p—anisyl—4—keto—tetrahydrothiazole, m.p. 108°, semicarbazone, m.p. 120°; and 2—p—phenetylimino—3—p—phenetyl—4—keto—tetrahydrothiazole, m.p. 126°, semicarbazone, m.p. 140° have been prepared.

(2) 3—Aryl—2—arylimino—5—benzal—4—thiazolidones.

PRITHWI NATH BHARGAVA.

Some 3—aryl—2—arylimino—4—thiazolidones have been condensed with benzaldehyde and the derivatives are obtained in a crystalline form. As a result of this 3—phenyl—2—phenylimino—5—benzal—4—thiazolidone, m.p. 162°; 3—o—tolyl—2—o—tolylimino—5—benzal—4—thiazolidone, m.p. 155°; 3—p—tolyl—2—p—tolylimino—5—benzal—4—thiazolidone, m.p. 197° ; 3—p—bromophenyl—2—p—bromophenylimino—5—benzal—4—thiazolidone, m.p. 218°, 3—p—chlorophenyl—2—p—chlorophenylimino—5—benzal—4—thiazolidone, m.p. 212° etc. have been prepared. Further work is in progress.

171. Structure of Neem (Melia Azadirachta Indica) Gum.—part I.

S. MUKHERJEE and H. C. SRIVASTAVA.

The gum obtained locally in the form of light brown nodules has been purified by precipition with alcohol and obtained as a white powder: Ash 0.92%, $(\alpha)_D^{21\cdot5^\circ}$—70.6°; equivalent weight by titration with 0.1 N sodium hydroxide 1084. Pentosan content 15.8% and galactose content ca 19%. The gum is non-reducing, faintly acidic and contains nitrogen. On hydrolysis with 0.05N sulphuric acid, arabinose residues are split off. This sugar has been identified as its diphenylhydrozone m.p. 195—196°. The rest of the polysaccharide was further hydrolysed with N—sulphuric acid when D—galactose and an aldobionic acid were obtained. D—galactose was identified in the hydrolysed solution both as crystalline sugar m.p. 165—166° $(\alpha)_D^{36^\circ}$ + 81.8° (in water, equilibrium value) and also as methylphenylhydrozone m.p. 180—182°. Barium salt of the aldobionic acid had barium content 16.5% (calc. value 16.2%). The barium salt was methylated twice with dimethyl sulphate and alkali and once with CH_3I and Ag_2O. The methylated product was hydrolysed with N—sulphuric acid, neutralised and extracted with chloroform. The extract was evaporated and the residue oxidised with bromine. The lactone of the methylated sugar is being identified. The aqueous solution left after chloroform extraction was acidified and extracted with chloroform. The extract was evaporated, oxidised with bromine and the lactone converted into methyl ester by boiling with 1% methanolic hydrogen chloride and the ester distilled. The identification of this ester of methylated glucuronic acid is in progress.

Examination of the hydrolysed gum on paper chromatogram indicated the presence of galactose, arabinose and a trace of another sugar which may be one of the rare sugars.

172. Constituents of Shellac. Part I. Butolic acid.

S. C. SEN-GUPTA and P. K. BOSE, Namkum, Ranchi.

A modified procedure has been adopted for the fractionation of the constituent acids of shellac. Shellac has been subjected to alkaline hydrolysis and sodium aleuritate separated. Next barium, zinc and lead salts have been prepared from the filtrate. A monohydroxy monobasic acid, named "butolic acid", has been isolated for the first time form the alcohol soluble but water insoluble barium salt. The comparative data for butolic and other probable monohydroxy acids go to prove that the new acid is a monohydroxy pentadecanoic acid, $C_{15} H_{30} O_3$. It has been obtained in an yield of 0.5% and is expected to be in the neighbourhood of 1% of shellac.

173. Fatty Oil from the seeds of Cassia fistula,Linn.

G. B. NADKARNI and V. A. PATWARDHAN, Sangli.

The brown seeds of Cassia fistula, Linn., Indian Laburnum, Purging Fistula, ('Amaltas', 'Bahava') yield about 5 per cent. of a coloured non-drying oil. It gives the following constants on analysis: Sp. gr. at 35° 0.9074, Refractive Index —at 29° 1.4720, Acid V. 7.7, Sap. V. 186.7, Iodine V. 95.4, Acetyl V. 14.9, Thiocyanogen V. 74.3, Reichert-Meissl V. 2.7, Polenske V. 0.2, Hehnex V. 89.4, and unsaponifiable matter containing 22.7 per cent. of sitosterol, 4.2 per cent.

The mixed fatty acids obtained from the oil contain 22.4 per cent. of solid acids and 77.6 per cent. of liquid acids, and give the following percentage composition:—Palmitic acid 14.8, stearic acid 4.8, lignoceric acid 2.8, Oleic acid 52.5 and linoleic acid 25.1. The unsaponifiable matter and the non-fatty matter in the steds are under investigation.

174. Chemical Examination of the Bark of Holoptelea Integrifolia.

RAJASHEKHAR C. BADAMI, Dharwar.

Preliminary examination of the bark of Holoptelea Integrifolia showed the presence of free acids, a small amount of reducing material and the absence of alkaloids and tannins. On steam-distillation of the powdered bark (200 grms.), and extracting the distillate with ether, a small amount of a greenish solid was obtained.

The powdered bark (50 gms.), was extracted in a soxhlet apparatus successively with various solvents, when the following percentages of extracts dried at 100°C, were obtained.

Petroleum ether extract	0.530%
Ethyl ether extract	0.572%
Chloroform extract	0.740%
Ethylacetate extract	2.640%
Alcoholic extract	7.780%
Total	12.262%

The alcoholic extract of the bark was separated into various fractions by extracting it with the common organic solvents.

Crystalline solids have been isolated from the petroleum ether and the ether extracts of the alcoholic extract of the bark.

Further work is in progress.

175. Starch Synthesising Enzymes of Green Gram.

J. SRI RAM and K. V. GIRI, Bangalore.

The starch synthesising enzyme system of green gram (Phaseolus radiatus) has been investigated. Two enzymes identical with phosphorylase and Q-enzyme isolated by Peat and his coworkers from potatoes, peas etc. could be isolated from this source also, which indicates that the mechanism of starch synthesis in all these cases is essentially similar.

Some properties of the two enzymes from green gram have been described. The phosphorylase has 6.3 for its optimum pH and 55°C for its optimum temperature. It was found to be a stable enzyme unaffected by dialysis, ultra-filtration and a variety of substances like sugars, vitamins and metallic salts.

The Q-enzyme exerted its maximum activity on amylose at pH 7.0 and at 24°C. It lost its activity completely at 50°C.

176. Nutritional Survey on Available Food Materials . Part I. Wheat Flour, Atta and Millets.

G. C. ESH and K. N. BAGCHI, Calcutta.

Fifteen samples of wheat flour, twentytwo samples of atta and five samples of whole wheat, collected from different parts of Calcutta were analysed and their nutritive value was determined. Samples of jowar, bazra and maize were collected from Indian Agricultural Research Institute and similar samples were procured from the local market. All of them were subjected to analysis in order to determine their nutritive value. The analysis for proximate constituents indicates that the composition of the flour and atta samples does not materially differ from the average values recorded in the literature. The protein content of the whole wheat, samples seems to be lower than that of good quality wheats. The relatively lower values for digestibility and biological value substantiate the view that the wheat samples are either inferior in quality or considerably damage has occured due to inferior storing conditions. The microscopic examination tends to indicate that the characteristics of the wheat starch have been maintained in all the samples showing that no adulteration has been made. The thiamine content of the samples has been found relatively low. The biological value of the millets has been found higher than that of wheat, the digestibility remaining almost the same.

177. Nutritional Survey on Available Food Materials Part II. The effect of parboiling, milling and storage on the nutritive value of Rice.

G. C. ESH, J. SOM and K. N. BAGCHI, Calcutta.

1. Six varieties of rice treated in different way—raw milled, raw home-pounded, paraboiled milled and parboiled home—pounded—were analysed for various

chemical constituents and the nutritive value of their protein and thiamine content were determined. While there is not much variation either in the chemical composition or in their nutritive value from sample to sample under the same kind of treatment, parboiling conserved more nitrogen, total minerals and phosphorus, but the process seems to depress the digestibility of protein.

2. Same variety of un-husked rice stored for long periods varying from 2—4 years under uncontrolled condition—were analysed to determine their nutritive value. The samples have the tendency to decrease in protein and fat content but increase in minerals along with storage. The digestibility has the tendency to decrease but the biological value increased. Both the raw and parboiled samples lost thiamins significantly along with storage.

3. Milled rice stored under uncontrolled conditions on analysis showed the same trend of changes both in composition and nutritive value as observed in stored unhusked rice, the extent of change being greater here.

178. Observations on the Survival of Ova of Intestinal Parasites in some Sewage Treatment Plants Around Calcutta.

K. SUBRAHMANYAN, T.R. BHASKARAN and M.A. SAMPATHKUMARAN, Calcutta.

In view of the widespread interest manifested in the utilization of sewage and sludge for agricultural purposes the question of survival of ova and cysts of intestinal parasites such as E. histolytica, ascaris and hookworms during various stages of sewage treatment is of great public health importance.

In this paper the authors have presented quantitative data on the presence of helminths in sewage at different stages of treatment in three different plants near Calcutta. A technique for quantitative enumeration of ova and cysts in sewage samples has been standardised. Sewage samples collected from the Palmer Bazar Pumping Station and the Activated Sludge plants at Batanagar and Bhatpara have been examined for the presence of helminths. The results show that sewage in Bhatpara treatment plant has a greater concentration of ova than in sewage from Palmer Bazar pumping station or Batanagar treatment plant. The percentage of removal of parasites is also greater in Batanagar plant than at Bhatpara treatment plant. The efficiency of removal has been correlated with the efficiency of purification of sewage as shown by chemical analysis.

With a view to obtain adequate data for full statistical interpretation, the observations are being continued during different seasons of the year.

179. Studies on Algal Photosynthesis in Relation to Oxygenation of Water.

M. A. SAMPATHKUMARAN and T. R. BHASKARAN, Calcutta.

A number of workers in Tropical Limnology have recorded phenomena of oxygen super saturation of water due to photosynthetic activity of chlorophyllous algae and other aquatic plants. However, precise quantitative data are not available on the oxygen-donating power of various species of algae commonly found in surface water sources in India.

In a continuous flow apparatus devised by the authors for studying this aspect of the subject, mixed cultures of algae comprising species of Oscillatoria, Phormidium, Microcystis, Scenedesmus, Cholrella, Spirogyra and Cladophora, Desmids and Diatoms have been subjected to experiment. The results obtained have been correlated with varying periods of exposure, light intensity and population density. Further work using pure cultures are in progress with a view to determining the relative value of the different species in maintaining oxygen balance in the aquatic medium.

180. Comparative biological availability of iron from ricegrains fortified with ferrous sulphate, ferric chloride and ferric orthophosphate.

JAGAT JIBAN GHOSH, Calcutta.

Ricegrains, fortified with $FeSO_4$, $FeCl_3$ and $FePO_4$ at two different levels viz., 36 μ gm and 55 μ gm per gm. of rice, were fed to rats which were previously made nutritionally anaemic by keeping on milk diet. The results of haemoglobin (Hb.) determinations at different stages revealed that after 28 days, at an iron intake level of 35 μg per gm. of rice the corresponding Hb. values of $FeCl_3$-supplemented, $FeSO_4$-supplemented and $FePO_4$-supplemented groups had increased by 47, 43 and 20 units respectively, whereas at the iron intake level of 55 μg per gm of rice, the Hb. values of the above groups had increased by 48, 47 and 33 units respectively. The corresponding Hb. value of negative control group was found to increase by 14 units only. Comparing the figures for haemopoiesis at two different levels of iron intake, it appeared that ferric chloride and ferrous sulphate had greater haemopoietic effect than ferric orthophosphate in enriched ricegrains. Between ferrous sulphate and ferric chloride there was no appreciable difference so far as haemoglobin regeneration was concerned.

181. Studies on the critical moisture requirements of some of the rice-inhabiting fungi.

JAGAT JIBAN GHOSH, Calcutta.

Observations were made on the relative germinative ability of the spores of different isolates of rice-inhabiting fungi on (a) dried gelatine (b) dried gelatin plus dextrin (c) dried gelatin plus rice starch (d) dried gelatin plus rice extract (e) dried gelatin plus dextrin, rice starch and thiamin. All the media were kept exposed at different relative humidities (R.H.) ranging from 70% R.H. to 100% R.H. The results of the spore germination tests at different relative humidities indicated that the Mucor, Fusarium and Cladosporium species required higher humidities viz., above 85% R.H. for their successful growth. Members of the Aspergillus species generally were found to grow at relatively low humidities. Members of the A. glaucus group and A. candidus group were most prominent, as the latent period of spore germination of these two fungi were remarkably shorter in comparison to that of the other fungi. The Penicillum species, in general, had got a wide humidity range viz. 80% to 100% R.H. within which they exhibited their spore germinating abilities. The presence of various nutrients such as rice extract in the medium remarkably reduced the latent period of spore germination in all the cases examined.

182. Studies in the Behaviour of different Substrates towards Yeast Invertase.

M. M. BISWAS, Calcutta.

Invertase extract from 1,320 gm. dried brewer's yeast powder was dialysed and then precipitated between 0° and 5°C at pH 4.5 and 50% alcohol. The precipitate on centrifugalisation was dissolved in water. Percentage of protein in this solution was 2.97. Varying proportions of this enzyme solution were allowed to hydrolyse sucrose, raffinose and inulin at 37°4C. Variation of invertase activity of this enzyme solution with concentration of the enzyme has been graphically represented for the three substrates. The sample of invertase was found to hydrolyse inulin, sucrose and raffinose to a considerable degree. It has also been observed that behaviour of this invertase towards sucrose and raffinose is practically of a similar nature whereas the reaction with inulin is of a specific character. Possibility of the presence of a specific enzyme inulase in addition to the usual β —D—fructofuranosidase in the sample of invertase preparation has been discussed.

……

183. Electro-chemical Properties of Solutions of Yeast Nucleic Acid.

A. R. GHOSH and S. N. MUKHERJEE (Jadavpur), Calcutta.

On titration of yeast nucleic acid with alkali the pH rises very slowly and shows two inflexion points, although none of them is very pronounced. The nature of the curve gives indication of the liberation of titratable basic groups (viz., the —NH_2 and —NH groups of the purines and pyridinines) and acid groups (viz., the primary and secondary phosphoryl dissociations) during titration with acid and alkali. The two inflexion points lie in the pH regions 4.8 and 7.2, the second being more pronounced. Thus the acid appears to resemble a dibasic acid having the dissociation constants close to one another, so that the final form of the titration curve presents the characteristics of a slow continuous inflexion. The equivalent weight has been calculated to be 315, which gives a molecular weight 1260, against the theoretical value of 1303.

Conductometric studies are also made. The plot of equivalent conductance against square root of concentration gives a straight line at lower concentrations and deviates from linearity at higher ones and this is in accordance with theoretical expectations. Conductometric titrations with 1 : 1 base show two inflexions and the equivalent weight obtained herefrom is also of the same order as that from potentiometric measurements.

Sodium yeast nucleate solutions on titration with acid or alkali does not show any peculiority.

184. Itaconic acid production by Aspergillus terreus.

K. RAMACHANDRAN and (Mrs.) ZUBIADA H. OSMANI, Hyderabad-Dn.

Itaconic acid has been recently discovered to be a fermentation product of sugar and its manufacture at a low price may lead to its application in the plastic and detergent industries. In this paper a brief review of the existing literature on its formation is given and the experiments carried out to study its production by Aspergillus terreus are described. In several experiments it has been found that 40% yields of itaconic acid from glucose can be obtained in 'synthetic' media assuming that one mole of glucose gives rise to one mole of itaconic acid. The optimum concentrations of the inorganic salts and of glucose, the initial pH of the medium etc. have been studied. Further experiments using added nutrients like corn steep water, bran extract etc. and with aeration in surface and submerged cultures are in progress.

185. Microbiological Production of Citric Acid. Part 1.

H. D. SEN, P. S. VARMA and R. H. SANKHALA, Kanpur.

Citric acid is imported in large quantities in our county. The raw materials for its manufacture are available in plenty. Wehmen's process has been commercially developed in foreign countries, and many patents have been taken by various workers. A detailed investigation of this process has been made with special reference to all the facts influencing the production of citirc acid by undisturbed surface culture fermentation.

186. The effect of anti-bacterial substances on the marrow alkaline phosphatase.

B. V. BHIDE and (Miss) L. MULHERKAR, Poona.

The effect of anti-bacterial substances on enzyme activity has not been studied extensively. In the present investigaaion the effect of such substances on bone marrow phosphatase activity has been studied. This phosphatase shows maximum activity at pH 11, Sulfathiasole inhibits phosphatase activity while Sulfa diazene is without any effect. Sulfanilic acid and para amino benzoic acid, phosphanilic acid also retard the reaction rate. Urea retarde slightly, carbamido phosphanilic acid and dimethyl amino phenyl phosphinic acid accelerate phosphatase activity. The results are discussed.

187. The production of Acetone bodies by E. Coli.

M. C. NATH and (Miss) K. S. LAUL, Nagpur.

1. It is observed that E. Coli produce Acetone Bodies from peptone and butter fat.

2. The amount of acetone bodies produced increases with increasing concentration of fat.

188. Studies on the Biosynthesis of vitamin C and a probable precursor.

M. C. NATH and (Miss) B. BELAVADI, Nagpur.

1. Though glucose has got a slight effect in the process of Biosynthesis of vitamin C in the germinating legumes and acetoacetate has a retarding effect, the product formed by condensing the two (2-tetra hydroxy butyl 5-methyl 4-carbethoxy furan) has been shown to accelerate the process considerably.

2. 5 mg. of this product per 100 seeds have been found to be more effective than a much higher concentration of glucose, 100 mg. per 100 seeds.

3. The results with the product, after 96 hours' germination, seem to be 100% higher than those with the equimolecular amount of glucose.

4. If this condensation product is allowed to be acted upon by H_2O_2 at pH 6.8 at 37°C. for 24 hrs., it has but a retarding effect in the process.

5. Glucose in presence of acetoacetate (equimolecular proportion) causes some increase in vitamin C only after 48 hrs.

6. A probability of the condensation product of glucose and acetoacetate being as a precursor to the formation of vitamin C has been suggested.

189. Effect of Vitamin B_1 on the Bio-synthesis of Vit. C in Leguminous Seeds (Green Gram).

M. C. NATH and R. P. CHITALE, Nagpur.

1. Vitamin B_1 has some effect in the process of Bio-synthesis of vitamin C during the process of germination.

2. Effect of concentration of vitamin B_1 has been observed in the production of vitamin C.

3. Degree of Bio-synthesis of vitamin C in the aqueous medium (pH 7) and in presence of phosphate buffer (pH 7.2) does not seem to change appreciably.

190. Synthesis of acetic acid from methanol and carbon monoxide at high pressures and temperatures in the vapour phase in presence of nickel catalysts.

S. SOURIRAJAN and S. K. BHATTACHARYYA, Bangalore.

The synthesis of acetic acid from methanol and carbon monoxide was studied in the vapour phase in presence of various nickel catalysts at pressures up to 3800 lbs./sq. in. and temperatures up to 210°C. Twenty-two different catalyst concentration and methods of preparation was studied at 210°C. and 3800 lbs./sq. in. compositions were tried. The influence of various supports, promoters, catalyst working pressure. Nickel iodide catalyst supported on silica gel was found to be very active. The yield of acetic acid was found to pass through a maximum as the concentration of nickel iodide in the silica gel was increased. A catalyst containing 50% nickel iodide was found to be most active and gave a 37.0% process yield at the temperature and pressure stated above.

191. Studies on Polymerisation. Part I. Thermal polymerisation of ethylene at high pressures.

S. K. BHATTACHARYYA and S. MUTHU, Bangalore.

Polymerisation of ethylene was studied in absence of any catalyst at temperatures up to 450°C. and pressures up to about 7400 lbs./sq. in. At temperatures below 290°C. there was practically no reaction even when the pressure was increased to 6500 lbs./sq. in. The rate of polymerisation was found to increase with increase in both temperature and pressure. The nature of both liquid and gaseous polymerised products was found to depend entirely on experimental conditions. Pressures below 7000 lbs./sq. in. and temperatures above 320°C. were found to be favourable for the formation of gasoline and lubricating oils. Lower temperatures and high pressures were found to be very favourable for the formation o semi-solid or solid polymers. Thus, at a temperature of 380°C. and a pressure of 5200 ℔s./sq. in. ethylene on polymerisation gave 91.5% of the theoretical yield of liquid hydrocarbons, having a boiling range from 30° to above 275°C. The liquid polymer was analysed in every case by distilling the product into a number of fractions and determining tht specific gravity, refractive index, bromine number and per cent. saturation of each fraction.

192. Reactions in the vapour phase—Part III. The catalytic oxidation of croton aldehyde to maleic acid in the vapour phase.

N. VENKATARAMAN and S. K. BHATTACHARYYA, Bangalore.

In continuation of our investigations already reported, (Proc. 38th Ind. Sci. Cong., Part III: Abstracts) the vapour phase oxidation of croton aldehyde to maleic acid was studied employing the vandates of tin, bismuth, lead and silver ac catalysts and also a double oxides catalyst having the composition, V_2O_5: MoO_3 :: (85:15) under different experimental conditions. Of the vanadates, tin vanadate was found to be most active. The activity of the vanadates was found to be in the order: tin > bismuth > lead > silver. Tin vanadate supported on Kieselguhr was found to be much inferior to the unsupported tin vanadate, which gave, per single pass, a yield of maleic acid 42.8% of the theoretical value, at 225—235°C. and at a space velocity of 10.5×10^3 litre/hr./litre of the catalyst, airi/aldehyde ratio being of the order of 140. Higher air/aldehyde ratios gave better yields, a yield of 50% of the theoretical being obtained with a ratio of 591; but from the commercial stand point, higher ratios are not of much interest. The double oxides catalyst (V_2O_5:MoO_3 = 85:15) supported on Kieselguhr was found to be more efficient than tin vanadate and hence a detailed investigation on the performance of this catalyst was carried out. Kieselguhr was found to be a better catalyst support than Kaolin, pumice or calcium sulphate. The yield of maleic acid was found to attain a maximum value as the concentration of the oxides in the catalyst support reached 20% oxides on the total weight of the catalyst. The efficiency of the catalyst prepared by the thermal decomposition of the mixture of the oxalates of vanadium and molybdenum was found to be much better than that prepared by the decomposition of the ammonium salts. As in the case of tin vanadate, the yield was found to increase greatly with increase in air/aldehyde ratio. The catalyst prepared from the oxalates, and supported on Kieselguhr gave yields of maleic acid 45.3% of the theoretical value, when air benzene ratio was 140 and 58.0%, when this ratio was 623, at 310—315°C. and at a space velocity of 10.5×10^3 litres/hr/(litre of the catalyst).

The reaction was found to be attended with a major side reaction involving polymerisation of croton aldehyde by both thermal and catalytic processes.

193. Synthesis of propionic acid from ethylene, carbon monoxide and water at high pressures and temperatures in the vapour phase using cobalt catalysts.

S. K. BHATTACHARYYA and S. SOURIRAJAN, Bangalore.

The reaction between ethylene, carbon monoxide and water leading to the synthesis of propionic acid was studied in the vapour phase in presence of various cobalt catalysts at temperatures up to 250°C. and pressures upto about 6000 ℔s./sq. in. Kieselguhr and silica gel were employed as catalyst supports. Eight catalyst compositions were tried under different experimental conditions. Silica gel was found to be a much better support than Kieselguhr. The nature and quantity of the product obtained were found to depend greatly on the treatment given to the catalyst at the end of each experiment and also on the working temperature and pressure. Thus, when the catalyst having the composition Co : Fe : ThO_2 : MgO — Kieselguhr (30 : 1 : 2 : 2 : 66) was reduced for two hours at the end of each experiment in a current of hydrogen at 400°C. for using it in the next experiment, the liquid product obtained was found to contain mainly propionic acid contaminated with very small quantities of aldehydes and traces of alcohols and esters, but, not with any hydrocarbons. On the other hand, when, at the end of each experiment, the carbon deposited on the catalyst surface was removed by passing a current of air or oxygen for four hours at 300°C. and then the catalyst was reduced in a current of hydrogen at the same temperature for the same period for using it in the next experiment, the treatmnt was found to have an extraordinary effect on the activity of the catalyst. In this case, not only the yield of propionic acid was found to increase but also considerable and almost an equal amount of liquid hydrocarbons (mostly unsaturated) was formed as a by-product of the reaction. The catalyst, treated as above, gave a 14.5% process yield of propionic acid and a 19.0% process yield of liquid hydrocarbon at a temperaturt of 180°C. and a pressure of 4500 ℔s./sq. in. The yield of propionic acid was found to pass through a maximum with the increase in temperature as well as in pressure, and to be independent of the amount of water used, but dependent on the C_2H_4 : CO ratio, 1 : 1 ratio giving the optimum yield.

194. Isolation of ingredient compounds from Anthracene Oil.

P. C. GUHA and S. S. GUHA, Baangalore.

Anthracene oil (10 litres) supplied by the B.C.P.W. was fractionated in four fractions: I. b.p. 195—200°C; 400 c.c.; II. b.p. 200—250°C., 4000 c.c.; III. b.p. 250—325°C; 3000 c.c.; IV. b.p. 200—340°/40 mm., 1156 grams. Fraction II gave acid soluble 112 g.; alkali soluble 373 g.; neutral 2751 g. Fraction III gave acid soluble 207 g.; alkali soluble 375 g.; neutral 2758 g. Fraction IV gave acid soluble 81 g.; alkali soluble 52 g.; neutral 1023 g.

The neutral portion (1023 g.) from fraction IV on standing gave 180 grams of solid leaving about 843 grams in the liquid state. The 180 g. solid melted within a very wide range of temperature and evidently was a mixture of many compounds. Both of them have been subjected to fractional distillation separately under reduced pressure.

The solid portion gave the following fractions: fraction 1, b.p. 157—60°/3 m.m., gave 8 crystalline solids; fraction 2, b.p. 160—65°/3 mm. gave 9 crystalline solids; fraction 3, b.p. 170—80°/5 mm. gave 10 crystalline solids; fraction 4, b.p. 180—90°/6 mm. gave a crystalline solid; fraction 5, b.p. 187—200°/5 mm. gave a cryst. solid; fraction 6, b.p. 200—210°/6 mm. gave 11 cryst. solids; fraction 7, b.p. 250—60°/5 mm. gave 12 cryst. solids; fraction 8, b.p. 269—310°/5 mm. grave 12 cryst. solids; fraction 9, b.p. 200—300°/4 mm. gave 16 cryst. solids; undistilled residue (black brittle mass, 385 g.). By careful successive crystallisations from organic solvents, good many of these solids have been found to be identical with known compounds. About one dozen compounds, it seems, have been isolated for the first time and are not described in literature. Identity of a few of the known compounds by physical and chemical methods are under confirmation. Structure of the new compounds is under study.

195. Production of Cellulose-pulp from Bagasse.

ABHAYA SINHA, Banaras.

The pulp and the pulping conditions and process for bagasse have been exhaustively investigated with a view to prepare a high grade pulp with maximum alpha-cellulose and low ash content for use in the manufacture of rayon and cellulose derivatives, besides the use of ordinay quality pulp required in the paper and craft manufacture. The sulphite, soda and nitric acid processes of pulping have been carried out with bagasse and the yield of pulp together with its quality, e.g. the alpha-cellulose content and the presence of other material than cellulose have been investigated. The yield of pulp, under ideal conditians of the experiment by the sulphite process has been found to be 50 per cent., 46 per cent. by the soda process and 51.2 per cent. by using alcoholic nitric acid solution in the nitric acid process of pulping. The use of certain salts, e.g. sodium sulphite and sodium bisulphite gave lower yield of pulp but the quality of the pulp has been found to be almost absolutely pure containing quantitative yield of pure alpha-cellulose.

Bleaching plays an important role in the preparation of refined and bleached pulps and the results obtained with different bleaching agents have been studied in detail. The analytical specifications of the bleached pulps in respect of its alpha-cellulose and other cellulosic and non-cellulosic fractions have been determined with a view to judge the quality of the pulp.

Bagasse pulp has been subjected to special refining and purification processes for use in the production of rayon and cellulose derivatives. The specifications and the quality of the refined pulps have been fully ascertained by determining the percentage of ash, ash alkalinity, ether extractives, lignin, pentosan, resin, alpha—cellulose together with beta—and gamma—fractions and the determination of Copper Number of the cellulose. The viscosity of the viscose prepared from bagasse pulp has been studied in detail with a view to judge the suitability of the pulp for rayon manufacture. The viscosity measurements and actual spinning tests of the viscose from bagasse have indicated that purified bagasse pulp is suitable for application in the rayon industry.

The analytical specifications obtained on analysis of the refined bagasse pulp have been found to be:—

Ash	0.2	in terms of percentage of	refined bagasse pulp.
Ash alkalinity	1.9	,,	,,
Ether-extractives	0.3	,,	,,
Lignin	0.4	,,	,,
Pentosan	2.6	,,	,,
Resin	0.2	,,	,,
Alpha-cellulose	95.2	,,	,,
Beta-cellulose	0.8	,,	,,
Gamma-cellulose	1.0	,,	,,
Copper Number of the Bagasse pulp	1.3	,,	,,

196. Analysis, Ultimate composition and Fuel value of Bagasse.

P. S. VARMA and ABHAYA SINHA, Banaras.

Several samples of bagasse, fresh, air and sun-dried having different percentages of moisture have been analysed and the relative proportion of the constituents determined. The percentage of alpha-cellulose in the various samples has been determined as it is this cellulose which is used in the manufacture of rayon, acetate silk, other synthetic fibres, cellulose derivatives, etc. The percentage of alpha-cellulose varies from 62.4 to 65.0 in different samples as determined by Cross and Bevan modified chlorination, Norman and Jenkins and by Norman and Jenkins soda processes.

The ultimate analysis or the elementary composition of several samples of bagasse has been determined and found to contain carbon 46.71 to 48.28; hydrogen 6.30 to 6.49; nitrogen 0.15 to 0.18 and oxygen 45.05 to 46.73 per cent. respectively calculated on the basis of 100 parts of water and ash-free bagasse.

The fuel value of several of samples of bagasse having different moisture contents has been determined by making use of a Bomb Calorimeter. The maximum calorific value of dry bagasse has been found to be 8350, of sun-dried samples containing 8 per cent. moisture 7450, and of fresh bagasse containing 42 per cent. moisture 4750 British Thermal Units per ℔. respectively.

197. Recovery of Copper from low grade Sulphide Ores.

G. R. PHANSALKAR and D. H. (Vidwans), Banaras.

India has considerable deposits of sulphide ores of copper; but since they are not all of very good quality, a procedure, particularly for the low grade ores which would recover copper from these would be desirable. Since electrolysis of copper sulphate is known to give very pure metal and is also commercial in its operation an attempt has been made to convert sulphide ore directly to copper sulphate using air for oxidation.

Experiments were undertaken in a specially designed apparatus; the principal parts of which were a reaction chamber, a steam generator and a suction pump. The reaction chamber was provided with perforated shelf on which a thimble containing powdered ore rested. The steam along with air was drawn in from the bottom of the reaction chamber towards an exhaust situated at the upper end by creating partial vacuum with the help of the pump.

By the interaction of steam, air and sulphide a part of the latter was oxidized and the resultant $CuSO_4$ dissolved in the condensed water and was periodically tapped off.

Influence of temperature and rate of air flow were investigated; approximately 15% recovery was observed at 80°C and at 60 puffs of air per second.

Further experiments are in progress.

198. Studies on Electrodeposition of Colours.

N. N. S. SIDDHANTA, Banaras.

Colouring of metal cathodes by electro-deposition of thin films of copper oxide was studied. Three baths were investigated; these contained copper sulphate and lactic acid, citric acid or Rochelle salt respectively, together with sodium hydroxide. Coloured films could be deposited only from appreciably alkaline solutions. Baths containing about 10.0 gms. of $CuSO_4 5H_2O$, 10 — 12 gms. of acid or Rochelle salt and about 10.0 gms. of sodium hydroxide were found suitable. Current density of 0.05 — 0.1 amp/dm^2 was found to be most effective. The shade of the film was found to vary with the duration of electrolysis; a marked change being obtained after every 15—20 seconds. Uniform and adherent films of different shades were obtained in the following order: orange, pink or red, blue, violet, green, white and yellow. It was interesting to note that after yellow the colour changed to orange and the above order was repeated. The temperature of the bath solution was found to have no appreciable influence on the process.

199. A Study on Electrodeposition Qof Chromium-Tungsten Alloy.

N. N. S. SIDHANTA and B. D. TEWARI, Banaras.

Electrodeposition of an alloy of Cr and W was tried from a bath containing chromic acid, tungstic acid and ammonium citrate. The deposition was studied with respect to the following factors: electrolytic concentration, temperature, duration of electrolysis, current density, interelectrode distance and addition agents. The bath yielding the most satisfactory deposit contained 20 gms. of chromic acid, 10 gms. of tungstic acid and 26 gms. of ammonium citrate. The pH of the bath was not very critical and was kept at about 8. The optimum conditions as regards the other factors are as follows. Temperature of 60—70°C, duration of 60—90 mts. electrolysis were found most suitable. The current density was exceedingly high viz., 2.1 amps./sq. cm. The interelectrode distance was 0.5 cms. The current efficiency in all the experiments was found to be extremely low.

200. Studies on Indian Talcs—Part I. General, Chemical and Mineralogical Characteristics.

ATMA RAM, J.C. BANERJEE, S.B. ROY and Y.P. VARSHNEY (Jadavpur), Calcutta.

Available literature on the uses of talc in the ceramic industry as well as its special features which are likely to be of interest to the ceramists have been reviewed. 28 samples of Indian talcs collected from different parts of the country have been studied for their general, chemical and mineralogical characteristics. They have been classified on the basis of their chemical and petrographic properties. Properties such as colour and shrinkage on firing and water absorption at 1350°C have also been studied. The colour obtained on firing the samples has been used as a criterion in evaluating the utility of talcs. The effect of heat (up to 1000°C) on 7 talcs (raw) has also been investigated, and the curves obtained have been found to be indicative of the nature of impurities present.

201. Studies on Indian Tales—Part II. Properties on Firing.

ATMA RAM, J.C. BANERJEE, S.B. ROY and Y.P. VARSHNEY (Jadavpur), Calcutta.

A study has been made of the firing characteristics and the fired properties of 7 Indian talcs collected from different parts of the country. Properties like fired colour, linear shrinkage, water absorption, apparent porosity. bulk and apparent specific gravity, transverse strength, moisture expansion, were determined on samples fired to 1000°, 1100°, 1200°, 1250°, 1300°, 1350° and 1400°C. Thermal expansion and thermal endurance data have been obtained on samples fired to 1350° and 1400°C. It is shown that the chemical analysis together with petrographic analysis may be used as a preliminary guide in predicting the firing characteristics and the fired properties of talcs. The effect of lime in reducing the firing range, and that of alumina and iron in lowering the vitrification temperature has been studied. Out of the samples investigated the talc received from Jaipur appears to be the best.

202. On Glass Bottles suitable for containing inks.

ATMA RAM, S. P. KRISHNASWAMI, P. ROY and Y. P. VARSHNEY, Calcutta.

Inks are usually kept for normal use in glass containers. Sedimentation on keeping in these containers adversely affects the quality and usefulness of the ink. The formation of the sediment or deposit may be either due to the inferior quality of the ink or the poor resistance of the glass container to the action of the fluid.

India has now a growing ink industry and ink manufacturers have experienced this difficulty. With a view to remedying this defect several Indian and foreign inks and ink bottles have been examined, particularly with regard to the quality of the glass containers. The tests prescribed for determining the suitability of glass containers for keeping inks have also been examined and suitable modifications are under consideration. Compositions of glass batches for making bottles suitable for containing inks are proposed.

203. Utilisation of salt cake in the Indian Glass Industry.

ATMA RAM, S. C. MAJUMDAR, K. D. SHARMA and Y. P. VARSHNEY, Calcutta.

With a view to utilizing the naturally occurring salt cake in the country the investigation reported upon was taken up. Series of glass batches for a soda—lime—silica glass employing Didwana salt cake as the source of alkali in varying amounts, viz., 100, 50, 25 and 12½% of the total alkali required, have been melted with gradually increasing amounts of graphite and comparative observations made as to the rate of melting, the extent of fining, colour obtained and the attack on the refractory crucible in which the melting was carried out. The results show the range of proportions within which carbon is required to satisfactorily melt colourless glass from salt cake batches without undue corrosion on the refractory container. Such range has been found to become wider as the ratio of salt cake to soda ash in the batch decreases. Comparative meltings at 1350°C. and 1400°C. also show that when salt cake replaces soda ash in a glass batch to the extent of supplying up to 50 per cent. of the Na_2O the melting rate is not retarded, provided the founding temperature is maintained sufficiently high. In Part B of the paper systematic replacement of soda ash by salt cake for making amber glass has been made in a series of melting and the effect of moisture and of manganese dioxide up to 20 parts per 1000 parts of sand in such amber glass batches has also been indicated. It has been shown that amber glass can be produced without using sulphur. 5—10 parts of salt cake per 1000 parts of sand along with the necessary amount of reducing agents have been found necessary to produce the colour.

204. Effect of treatment with chemicals on the settling efficiency of lac wastes.

G. K. SETH, T. R. BHASKARAN and K. SUBRAHMANYAN, Calcutta.

The liquid wastes from the manufacture of seed lac have a high content of organic matter and proper sanitary disposal of these wastes presents a difficult problem to public health authorities in the country. Work on this problem has been undertaken with a view to find out suitable methods of treatment and disposal of these wastes.

In this connection experiments on sedimentation of liquid wastes with and without treatment with chemicals have been carried out. The following treatment methods were tried.

1. Plain sedimentation for different intervals of time.
2. Sedimentation after treatment with lime.
3. Sedimentation after treatment with chlorine.

From the results obtained on sedimentation without chemicals, it appears that the optimum period of settlement is half an hour. Within this period, most of the suspended matter is removed and a fair amount of B.O.D. is also removed. Prolongation of the period of settling beyond ½ an hour is not accompanied by commensurate increase in the removal of suspended solids or B.O.D.

Adopting half an hour as the period of settlement, further experiments were carried out on the settling efficiency of this waste with addition of chemicals.

The data obtained show that the settling efficiency is better in case of lime treatment than that of chlorine. With 500 ppm. of lime the reduction in B.O.D. is of the order (73%) whereas with the same concentration of chlorine it is of the order of (55%).

The results obtained show that treatment of waste with about 250—500 ppm. of lime is useful in reducing solids and organic matter of the waste and also adjusting its pH to a favourable range for biological treatment.

Further work on the usefulness of trickling filter treatment, and ponding methods, in reducing organic pollution from the waste is in progress.

205. Studies on the desulphurisation of high-Sulphur Indian Coals.

M. N. GOSWAMI and M. M. ROY.

Removal of Sulphur from Coal is a problem which has engaged the attention of scientists from the earliest times. Numerous works have been done and various patents have been taken but without any commercial success. The object of our present study is to establish or develope conditions for maximum desulphuri sation of Assam coals, and which will be successful at least from economical point of view.

Among the early works, Powell studied the problem by means of Hydrogen and by-product gas at temperature in the range of 700°C and obtained good results. R. D. Snow has observed the effect of passing H_2 for varying times and at different temperatures in presence of small concentrations of H_2O, HC1 and NH_3. Foerster and Geissler have studied the problem by passing steam and found that desulphurisation takes place at temperature at which the water gas reaction becomes active. Simmersbach and Wolffhave found that CO is more effective than H_2 upto 600°C and gives a good desulphurising action at 800°C. Mandlekar and Pai have inferred that sulprur may be removed considerably by treating the samples with oxides and chlorides of Calcium at different temperatures. Wheeler and Jolly observed that desulphurisation of bituminous coal could be increased from 30% by carbonisation of coal in a stream of N_2 to 48% by carbonisation in N_2 of a mixture of 2 parts of that coal with 1 part of anthracite. R. E. Brewer and J. K. Ghosh have found that ammonia in presence of catalysts like Al_2O_3 desulphurises coal considerably.

Among the Indian coals those from Assam collieries contain the Highest proportion of sulphur, the amount ranging from 2 to 7% and in some cases it comes upto 9%. It is also found that in almost all of them the sulphur occurs mostly as organic sulphur. In our case, the sample is from Baragolai colliery, Upper Assam, and it contains a total sulphur content of 4.57%, the organic sulphur being 3.99%. The coal is a good caking one having a low ash content. When the sample of coal is carbonised, the amount of sulphur in coke gradually decreases, the process being marked upto 800°C, after which desulphurisation goes on alright but very slowly and is maximum at 950°C when the sulphur in coke is 3.18%, the time of carbonisation being 2 hours. Pure Silica has some effect on the removal of sulphur from coal. Silica is known to possess acidic property at high temperature. When 5% Silica (on the weight of coal) is added to the sample, the corresponding sulphur retained in coke is 2.11% at the same temperature and the same time of carbonisation. At coke oven temp. which is about 1300°C, the sulphur in coke is reduced to 1.52% when the the time of carbonisation is 3 hours. Varying the percentage of silica has little or no effect on the removal of sulphur from coal. In all cases the coke obtained is a good caking one and shining in appearance. When sodium silicate is added, the desulphurisation is marked when the time of carbonisation is 2 hours and at 850°C, the sulphur in coke being 1.72%. Increasing the time of carbonisation increases the rate of desulphurrisation and when it is 6 hours the sulphur in coke is reduced to 1.52%. Decreasing or increasing the percentage of sodium silicate in coal as also variation in time of carbonisation has very little effect on the desulphurisation, and the sulphur content in coke lies practically between the limits 1.91 and 1.66%. In this case also coke oven temperature produces some interesting results. At this temperature, the percentage of desulphurisation goes on decreasing with increasing amount of sodium silicate, the time of heating being constant and 3 hours in each case. Apart from the explanation of this anomaly, it may be noted that in this case also the coke obtained is a good caking one and shinning in appearance. High temperature tar containing negligible sulphur content is found to have no marked effect on the removal of sulphur. The sample of coal mixed with 5% of the tar carbonised at 850°C for varying time desulphurises coal no doubt, but to a limited extent and is not so pronounced as in the previous cases. Ammonium Chloride when added to coal desulphurises coal considerably at high temperature. The coke obtained in these cases also are caking but not so well as in the previous cases. Further works in the above lines are in progress.

206. Production of Acetone from Ethyl Alcohol in one step process.

M. N. GOSWAMI and K. P. KOLEY, Calcutta.

Production of acetone from Ethyl Alcohol in one step process by help of the following reactions as given by Bernthsen $2CH_3CH_2OH + H_2O = CH_3COCH_3 + CO_2 + 4H_2$ (Bernthsen, Organic Chemistry, P. 161) had been carried out by various worker. Suen and his collaborator proposed (J. Chinese Chem. Soc. 1941, **8**, p. 131-39) conversion of alcohol to acetone with help of catalyst iron-oxide-calcium carbonate at temperature 500°C. Bloomfield, Swallen and Crawford (U. S. P. 1945 131) claimed that with catalyst Cr, Mn, Cu, and iron and an alkaline earth-oxide at temperatures 250-650°C, they had been able to produce acetone from alcohol. Some of these processes are now in commercial operation.

The present work was undertaken with a view to improve the yield and make it a commercially feasible process and simultaneously to convert it to Mesitylene with the help of suitable catalysts, as mesitylene may be used suitably as a petrol substitute owing to its aromatic and highly branched character. (Ind. Eng. Chem. 1947, p. 508).

The catalyst used for our purpose of conversion of alcohol to acetone was Fe_2O_3—CaO. The catalyst was prepared by different methods and was used at temperatures above 450°C. The ratio of the ingredients in the catalyst mixture was maintained at 1: 1. Yield increased as temperature was raised from 450°C to 550°C. Above 500°C, there was a tendency of the catalyst to become covered with carbon deposit formed by alcohol pyrolysis probably via Ethylene formation. With deposition of carbon the activity of catalyst diminished rapidly. "Alkalising" the catalyst by treatment of catalyst mixture with NaOH Soln. so that final mixture contained about 2% alkali (1.96% in actual experiment), increased the life period of the catalyst and prevented carbon deposition and also had a favourable effect on the yield. Using alkalised catalyst an yield of 20.6 gm. of acetone was obtained from 46 gms. of alcohol. Dilution of alcohol with steam had a favourable effect on the production of acetone. Use of supporter such as Kiesselguhr had some beneficial effect although not marked upon the yield.

Substitution of the glass reaction tubes with simple iron tubes led generally to conversion into aldehyde but when the inside was coated with a layer of ferroso-ferric oxide this side reaction did not take place and the conversion to acetone remained same as in the glass tube.

207. Investigation on the production of High-octane Aviation Fuels, Decanes and Octanes.

M. N. GOSWAMI and K. P. KOLEY, Calcutta.

Octanes and decanes possess high antiknock value and hence can be used in admixture with liquid fuels to raise their octane numbers.

Octanes had been manufactured from various Butyl alcohols viz. normal, iso and tertiary alcohols. These were converted to corresponding dibutylenes either directly using Sulphuric acid (Ipatieff and Komerwarsky, Ind. Eng. Chem., 1937, p. 958) or indirectly by first converting alcohols to olefines and polymerising them in presence of Phosphoric acid (Ipatieff and Corroson, Ind. Eng. Chem., 1935, p. 1069) and then hydrogenating the dimers. Decanes had been manufactured from various amyl alcohols. Cramer and Campbell (Ind. Eng. Chem., 1937, **29**, p. 234) succeded in preparing diamylenes from amyl alcohols by using concentrated H_2SO_4 at temperature below 80°C and them hydrogenated the dimers with platinum catalyst using glacial acetic acid solvent.

The present work was undertaken with a view to increase the yield of the hydrocarbons starting from various butyl and amyl alcohols and also to avoid the detrimental side effects at the same time, varying the liquid phase catalyst composition and altering the condition of reactions.

Dibutylenes were produced from normal, iso and tertiary butyl alcohols with success using sulphuric acid-phosphoric acid mixture (75 cc. of 75% H_2SO_4 and 50 cc. of 50% H_3PO_4 for 150 cc. of liquid gave the best result, yield being 65%). Dibutylenes were then hydrogenated with Raney Nickel catalyst, under pressure and at atmospheric pressure separately in glacial acetic acid solvent media at ordinary temperature. Amyl alcohols when used for manufacture of diamylenes with the help of sulphuric acid phosphoric acid mixture in various proportion with efficient cooling and followed by reflux, gave highly favourable yield (50-72%) Extensive charring and serious effect on the yield which occured when sulphuric acid was used alone (yield being only 30-45%) was wholly avoided by use of phosphoric acid mixture. Hydrogenation was carried out using Raney Nickel as catalyst. During hydrogenation rise of temperature had detrimental effect on the yield, yield being diminished with rise of temperature. Yield of hydrogenated products were 61% and 55% in cases of diamylenes and dibutylenes respectively.

208. The Sterols from Jute seed oils—Corchorus Capsularis. Part I.

NIRMAL KUMAR SEN and JIBAN KUMAR CHAKRAVARTI, Calcutta.

From the non-saponified portion of the oil of jute seed (Corchorus capsularis L) a new sterol had been obtained, which melted at 116°—123° in the crude state and on purification by chromatography (Brockmann's alumina), the melting point rose to 128°—129°, $[\alpha]_D^{30} = - 77^\circ.5$ (c, in chloroform).
Found: C, 83.92; H, 12.15%; M.W. 430 (Camphor. Rast). $C_{29}H_{50}O$ requires C, 84.05; H, 12.08%; M.W. 414.

It produces with trichloroacetic acid a pale pink colour; with chloral hydrate displays a change of colour from red to pale violet to pale blue and finally deep blue. It responds to Libermann-Burchard reaction. It contains one double bond. It forms a digitonide which decomposes without melting at 215°—220°; a benzoyl compound, m.p. 137°—139°, $[\alpha]_D^{31} = - 52^\circ.6$ (chloroform). Found: C, 83.10; H, 10.39%; $C_{36}H_{54}O_2$ requires C, 83.41; H, 10.42%, and an acetyl derivative, m.p. 120°—122°, $[\alpha]_D^{32} = - 70^\circ.1$.

Its molecular formula $C_{29}H_{50}O$ is isomeric with β and γ— sitosterols (Sandqeist et al, Ber. 1931, 64, 2167), cinchel (Liebermann, Ber., 1884, 17, 868), cupreol and quebrachel (Windaus, Ber., 1933, 66, 1254, 1689) and rhamnol (Dirscherl, Z. Physiol. Ch., 1935, 235, 1) but possesses higher specific rotation in chloroform and lower melting point than any one of the isomeric sterols. Evidently it appears to be a new sterol.

Further work is in progress.

209 Studies on the Rancidity of Butter-fat (ghee)—Part II.

S. N. MITRA, Calcutta.

The acid and the peroxide values of both cow and buffalo ghees stored for varying periods from a few months to three years, were determined to study the extent of deterioration and the development of rancidity in ghee.

The peroxide value was found to be a better test for rancidity than the usually done acid value; some extremely rancid and old samples showed barely significant rise in the acid values. Nevertheless, even the former test (peroxide value) for rancidity could not be considered as altogether satisfactory. The extent or degree of rancidity could not be correlated with the peroxide values, as an extremely rancid sample (one stored for several years) had even a less peroxide value than one which is only a few months old. Also, samples of similar character stored under identical condition for long period gave peroxide values varying over a wide range from nearly 20 to 90. Caution should, therefore, be exercised in trying to link the peroxide values with the extent of rancidity, that is to say, this chemical determination alone cannot always be taken as a quantitative measure of rancidity.

210. An economic Isolation of Berberine from an Indian Source.

H. G. BISWAS and N. K. MUNSHI, Calcutta.

A sample of Mishmi Teeta or Coptis Teeta (N. O. Ranunculacea) was sent to us by a friend from Sadiya, N. E. Assam. Its alkaloid content was found to be 8% by extraction and purification by the usual methods. As the cost of the crude drug is about Rs. 15/- per seer or kg and as from each seer about 3 ounces of berberine can be obtained it seems quite a profitable job to undertake the issolation of berberine from this indigenous source on a commercial scale.

211. (1) Lux (Red Mud) as a raw material for Rutile Bodies.

S. K. CHATTERJEE (Calcutta) and H. N. DAS-GUPTA (Dhanbad).

Within recent years high frequency ceramics have been developed, which meet all the requirements called for by the high frequency technique. Compositions suitable for such technique have been classed under different groups. Rutile bodies constitute one such grouping. These insulators are characterised by the fact that they are endowed with particularly low power factor, extremely high dielectric constant and negative temperature coefficient of the dielectric constant. Development of hese favourable characteristics in bodies containing titania are dependent upon the extent to which rutile crystals are formed. It has, however, been found feasible to prepare rutile insulator bodies from the red mud left after the separation of alumina from Indian bauxite. The mud requires some preliminary treatment so as to render it fit for insulation purpose. For rendering the prefired mud workable, Gangetic silt was used in place of plastic clay or bentonite. The electrical and other characteristics have been found to be in close agreements with those recorded by other workers.

212. (2) Studies on Ceramic Raw-materials. Part III.

S. K. CHATTERJEE (Calcutta) and H. N. DAS-GUPTA (Dhanbad).

In Part I of the present series (Das-Gupta and Chatterjee, J. Indian Chem. Soc., 1951, August issue) it has been established that ferric compounds, either inherent or artificially impregnated, suffer reduction in clays on being fired and that the adsorbed cations are mostly responsible for such reduction. The extent of reduction depends, amongst others, on the amount of ions adsorbed per unit mass of clay (exchange capacity) and the energy with which the different ions are held on the surface. In the present study a comparison of the reducing effect of different adsorbed cations on iron compounds has been made. For this, clays were first treated with hydrogen peroxide and then freed from the flocculating ions either by leaching with dilute acid or by subjecting them to electrodialyses. In either case, each clean clay was next saturated with different bases under identical conditions. Experimental results show that the extent of reduction varies with the nature of the adsorbed cations as follows:—

K > Na > Ca > Mg > H.

213. Studies on the development of Rancidity in Butter-fat (Ghee). Part I.

S. N. MITRA, Calcutta.

The development of rancidity and the deterioration of butter-fat in storage under different conditions are being studied. Two samples, one a buffalo ghee of commerce and the other prepared from New Zealand creamery butter, were taken for the experiment. Equal portions of each were stored in different ways, such as, in coloured and white glass bottles, tin container, earthenware jar, and in contact with an inert gas like CO_2 in normal day light as well as in the dark. The acid and the peroxide values were determined periodically for 5 to 6 months and the development of rancidity was noted simultaneously.

In both samples, storage in inert gas CO_2 stopped the onset of rancidity and the peroxide value from increasing over a period of 6 months even when the samples were kept in day light. In other cases, the peroxide values increased more or less. The acid values, however, did not increase significantly, although the samples turned distinctly rancid. The earthenware jar proved to be a good container for storage in case of one sample, but in the other it produced the least expected result, an abnormally high peroxide value and a highly rancid product.

So far, indications are that if ghee is stored in a suitable container in presence of an inert gas or out of contact with air, it keeps better.

214. Caffeine and tannin contents of Indian tea and their relation, if any, to the amount of non-tender stalks present.

A. K. SEN, S. N. MITRA and S. C. ROY, Calcutta.

Tea is not only a mixture of previously prepared and cured tender leaves and buds of the different species of Thea, but also that of the tender internodes and stalks of the plant. Presence of non-tender stalks in an undue proportion affects adversely its flavour and quality. Examination of good teas shows that while the presence of some amount of tender stalks is reasonable, percentage of non-tender ones is by comparison very low or almost nil. Presence of the latter cannot be detected by determining the standards of purity prescribed in most of the State Food Acts, namely, 'Ash', 'Soluble ash' and 'Total extract'.

The estimation of caffeine and tannin was undertaken to detect the presence of undue proportion of woody stalks, but this also did not help much as both these constituents varied within a fairly wide range, caffeine 2.5 to 4.5% and tannin, 8 to over 13%. These constituents were on the low side in the teas containing a high proportion of woody stalks, but not low enough to enable the analyst to detect with certainty the presence of the latter. The caffeine-tannin ratio of these samples was practically the same as that of the good teas.

Organoleptically, by liquor flavour and taste there is a distinct difference between the good teas and those containing woody stalks,

215. A study of the Fischer-Tropsch synthesis: Part II. Efficiency of the synthesis Process using Co-catalyst.

G. C. BASAK and N. C. NIYOGI (Sibpur), Howrah.

The efficiency of the reaction between CO and H_2 producing hydrocarbons and other bodies has been studied using a Co-catalyst prepartd in our laboratory.

For this purpose, a mixture of known volumes of CO and H_2 together with a little N_2 is passed over the catalyst at a known velocity and temperature. From the compositions of typical inlet and outlet samples taken simultaneously, the contraction in the volume of the gases taking place after the reaction is calculated. From this, the overall conversion efficiency expressed in percentage is calculated to be 82.64%. The percentage conversion to hydrocarbons other than CH_4 is found to be 66.15%. The yield of hydrocarbons in gms. per Cu.M of $(CO + H_2)$ is 171.7 gms. against a theoretical maximum yield of 196.6 gms. per Cu.M of $(CO + H_2)$.

The experimental results are discussed in details in the paper.

216. A Study of the Fischer—Tropsch Synthesis: Part I.—Catalyst.

G. C. BASAK and N. C. NIYOGI, B. E. College, (Sibpur), Howrah.

As is well known, the catalyst plays the most important part in the reaction between CO and H_2 producing synthetic petrol and other organic chemicals. A number of catalysts such as those prepared from Co, Fe, Cr.. etc. have been claimed by different workers to be effective, but the exact nature and composition and the method of preparation of the same are still not quite definitely known.

In our laboratory, a Co-catalyst consisting of a mixture of Co, MgO and ThO_2, the latter two acting as promotors, with Kieselghur as the supporting base has been prepared for the first time in this country by the following process.

A mixed solution containing definite amounts of nitrates of Co, Mg and Th is heated to its boiling temperature and instantaneously mixed and stirred with a boiling solution of $Na_2 CO_3$ of known strength. After precipitation a known weight of Kieselghur is added and the stirring continued for sometime. The precipitate after being filtered, is granulated and dried. The dried material is known as "Green Catalyst." The amounts of the different constituents of the catalyst are determined by analysis and its bulk density ascertained. The catalyst is ready for use after reduction with hydrogen at a temperature between 400° and 450°C.

217. Improvements in the Manufacture of Fructose from Cane-Sugar by the Calcium Fructosate Method.

L. M. SRIVASTAVE and S. H. ZAHEER, Hyderabad.

The process of manufacture of pure Fructose from Cane-sugar adopting the calcium Fructosate method which was described by us (Abstracts—Indian Science Congress, Chemical Section—1951) suffered from certain disadvantages such as loss of Glucose, difficulty in filteration of calcium Fructosate and time and expenditure involved in the decomposition of calcium Fructosate by carbon-dioxide. Experiments have now been conducted to improve upon the old process.

1. By hydrolysis of sucrose in aqueous alcohol, it has been found possible to separate Glucose from Fructose after further addition of Alcohol and cooling.

2. The invert sugar solution after separation of most of Glucose has been treated with lime for the precipitation of Fructose as Calcium Fructosate. The presence of Alcohol improved the yield and the nature of the ppt. which enabled rapid filteration.

3. Instead of carbon-dioxide, oxalic acid has been used to decompose the Fructosate, as this process of decomposition is found to be rapid and thereby prevented the loss of fructose.

Details have been worked out to eliminate completely the presence of oxalic acid in Fructose.

In corporating these improvements, a detailed procedure for the manufacture of Fructose from Sucrose has been described. The new process is not only quicker but also gives a better yield of Fructose.

218. Extraction of Alumina and Potash from Felspar by the action of acid.

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad, Dn.

Felspar is resistant to the action of acid. It is however completely decomposed if it is firstly heated at 800—900°C with three times by weight of Calcium carbonate and then subjected to the action of acid.

Felspar molecule is broken up with simultaneous separation of potash and alumina. Active silica is a bye-product.

219. White Cement from the sludge after the recovery of potash from Felspar.

ESHWAR RAJ SAXENA, D. S. Datar and S. HUSAIN ZAHEER,

Although the cement industry is well established and good quality cement is made in India yet white cement is not manufactured, as the rawmaterials for its manufacture which have to be free from iron are not available. The sludge after the recovery of potash from felspar by the wet and dry methods contain all the necessary ingredients for making cement. The material used in these processes is generally obtainable more or less free from iron. Felspar containing 0.5 % ironoxide was however used in these experiments. The sludge was calcined to obtained cement. The cement from the sludge of the wet method was light green in colour while that from the dry method was white.

220. Study on Devarkunda Calcite.

ESWAR RAJ SEXENA & D. S. DATAR, Hyderabad-Dn.

It is reported by the Department of Geological Survey of Hyderabad that Calcite from Devarkunda Taluq (Mehboobnagar District) is very pure and may be used for the manuufacture of bleaching powder.

It is seen that Calicite and Silica layers occur side by side. Only small crystals of Calcite can be picked out and freed from silica. The Calcite containing about 97 % calcium carbonate is separated but the process of separation is uneconomic and difficult.

Calcite deposit as such contains silica, alumina and ferric oxide to such an extent as to make its use prohibitive in the manufacture of calcium carbide or bleaching powder.

221. Thermal Decomposition of Calcium Sulphate.

(Miss.) RAZIA OSMANI and D. S. DATAR, Hyderabad, Deccan.

Gypsum is the only raw material that is available in large quantities for the production of sulphuric acid in our country. Sulphur dioxide is obtained by heating gypsum with silica, clay and coal at 1400°. The preliminary study undertaken for bringing about the decomposition of the sulphate at lower temperature indicates that although the decomposition of the sulphate at 900°C is not affected by the addition of silica or pure alumina, the presence of bauxite accelerates it to a considerable extent.

222. A new method for the preparation of ferrous sulphaate from iron pyrites.

K. N. MOORTHY and D. S. DATAR, Hyderabad (Deccan).

Ferrous sulphate is produced when iron pyrites and ferrosoferric oxide are heated at 800 to 900°C. out of contact with air. The conversion of pyritic sulphur to sulphate is about 84 percent of the theoritical yield. The presence of coke or coal in the reaction mixture has no efiect. The residue on heating does not contain any sulphide.

223. Preparation of Iron Sulphide from Coal Pyrites.

K. N. MOORTHY and D. S. DATAR, Hyderabad, (Deccan).

When iron pyrites is heated with ferrous or ferric oxide and coke or coal, iron sulphide is produced. The percentage conversion of sulphur in the pyrites to sulphide is maximum at 800°C. and when coke is used as reducing agent. The coke is added in excess. The yield is about 87 percent.

224. Effect of Metals on Rancidity.

S. M. HUSAINI and S. A. SALETORE, Hyderabad, Dn.

The effect of a series of metals and alloys on the development of rancidity in groundnut oil exposed to the air has been studied by means of a storage stability test carried out at room temperature in diffused light for periods of 54 and 85 days. Samples were examined at intervals for organoleptic quality and increase in peroxide value.

All the metals and alloys tested have been found to affect the oil adversely and peroxide values by themselves have not been of much help in evaluation of rancidity. Combined however with organoleptic condition it is possible to stato that silver and stainless steel have the least effect, aluminium and iron come next and zinc, tin and brass come afterwards. Copper and lead have the worst effect.

225. Investigations on Hyderabad Clays for Making Fireclay Refractories, Part II.

M. D. NARASIMHAM and S. H. ZAHEER, Hyderabad-Deccan.

The P. C. E. value of Pachegon clay is 1550°C (Cone20) which makes it suitable for making low heat duty fireclay bricks. The addition of grog increases porosity, reduces firing shrinkage and improves spalling resistance. There is no shrinkage on reheat. Further work is being done on the addition of bauxite and other clays with high P. C. E. value to Pachegaon clay for increasing the refractoriness and spalling resistance.

226. Activated Charcoal from Groundnut Hulls : use of Zinc Chloride as an Activating Agent.

H. A. KHAN and D. S. DATAR, Hyderabad-Dn.

Use of zinc chloride as an activating agent in the preparation of absorbent charcoal from groundnut hulls is investigated. It is found that ground nut hull impregnated with 40 % zinc chloride and carbonised at 320°C yields charcoal with adsorption capacity comparable with B. D. H. active charcoal. An experiment on a large scale (about 5 lbs. of the hull were used) gave similar result.

227. Activated Charcoal from Ground Nut Hulls: Use of Ferric Chloride as activating Agent.

H. A. KHAN and D. S. DATAR, Hyderabad-Dn.

Active charcoal with good adsorption power is obtained by carbonisation of groundnut hull predigested with ferric chloride. The charcoal exhibits higher adsorption of iodine and potassium permanganate but adsorption of methylene blue is slightly lower than that shown by charcoal prepared using zinc chloride as activating agent.

228. A Method for obtaining pure precipitated manganese dioxide from Pyrolusite.

K. N. MOORTHY and D. S. DATAR, Hyderabad-Dn.

Maganese dioxide is converted to manganous oxide and carbonate by heating with coal or coke at 800—900°C. The yield is 90 per cent. when coke is used. A process is developed based on this reaction for obtaining pure manganese dioxide from pyrolusite.

Pyrolusite is heated with coke. The residue is dissolved in dilute hydrochloric acid. To the neutral solution of manganous chloride concentrated solution of chloride of line (bleaching powder) is slowly added when pure manganese dioxide is precipitated.

229. Invesigations on Engobes.

BALABHEEM RAO and S. H. ZAHEER, Hyderabad-Deccan.

Suitable engobe for articles made of Pachegaon clay is developed. The composition and properties of body and underslip are given. Engobe mixed with body upto 10% gives good results. A lead borax fritted glaze is used to glaze the engobed articles.

230. Studies on Annona Squamosa (Linn.) Seed (sitaphal). Part III. Detoxication of seed oil for edible purposes.

N. BHOJRAJ NAIDU, MOHAN BABU NAIDU and S. A. SALETORE.

In order to put to edible use the 1,500 tons of sitaphal oil potentially available in Hyderabad State, it is necessary to detoxify it. While neither heating, steaming nor treatment with dilute or concentrated hydrochloride acid was effective, alkali treatment gave promising results; the loss in toxicity was influenced by the strength and amount of alkali, the temperature of reaction and the degree of agitation during treatment.

A refined oil, apparently free from toxicity towards insects like aphids and pumpkin beetles, was obtained by alkali refining with caustic potash (50 % in excess of the theoretical quantity required for neutralisation of the free fatty acids) in 2 stages.

This refined oil however proved edible to the extent of 50 % only when fed to white mice.

A fully edible oil was obtained by precipitation of the toxic matter by means of petrol ether followed by alkali refining.

The work is in progress.

231. Economics of Annona Squamosa (Linn.) Seed Production in Hyderabad.

N. BHOJ RAJ NAIDU and S. A. SALETORE, Hyderabad-Deccan.

During the fruiting season of August-November an estimated 1.5 lakhs of custard apple fruits are produced wild over about 56,000 acres of forest in Hyderabad state; imports are negligible and exports comprise about 1,785 tons. It is estimated that the fruits could give 7,500 tons of seed annually, if collected and that by not utilising same, the State of Hyderabad loses approximately 1,500 tons of oil, of which about 18 % would be available from the twin cities of Hyderabad and Secunderabad. The cake is rich in nitrogen (4.3 %) and may find use as a manure, while the oil may be used either for insecticidal, soap-making or (if rendered so by alkali-treatment) for edible purposes. The importance of an organised effort for the collection of seed, the oil from which alone is estimated to be worth Rs. 30 lakhs, is stressed.

232. Dehydration of Castor Oil by Tetra-Boro-Hypo-Phosporic Acid as a Catalyst.

V. A. SARAF and K. K. DOLE, Poona.

The dehydration of castor oil was carried out by using Tetra-boro-hypo-phosphoric acid $B_4O_7(H_2P_2O_6)_2$, as a dehydrating catalyst. Its activity both under atmospheric, as well as under reduced pressure, was studied. It was observed that 0.7 % of the catalyst, under atmospheric pressure, gave complete dehydration. Under reduced pressure the percentage of the catalyst required for complete dehydration was 0.4 %. The following are the values of the oil dehydrated by using this catalyst.

Iodine Value (Woburn) 150.4 ; Hydroxyl value—40.6 ; Acid value—10 to 11 ; Molecular Weight—1003, (determined cryscopically by observing the depression in freezing point of benzene); Conjugation 16 to 17 %; Ref. index at 40°C, 1.4660; Saponification value—198.5;

Study of some more heteropoly acids as dehydrating catalysts is in progress.

233. Dehydration of Castor Oil with "Mixed Alkane Sulphonic Acid" As a Catalyst.

A. S. RAJADHYAKSHA and K. K. DOLE, Poona.

Mixed Alkane Sulphonic Acid can be successfully used for the dehydration of castor oil 0.4 % of the catalyst, at 270°C. and at ordinary pressure, gives complete dehydration of the oil. The time of reaction was 60 minutes. The catalyst, however, gives dark coloured oil, with a high acid number. The decomposition of the oil increases with the time of reaction and with the percentage of the catalyst used.

0.4 % of the catalyst under atmospheric pressure and at 270°C. gives the following results.

Iodine Value : 145.3. Hydroxyl Value 17.6. : Acid Value : 13.8 Saponification Value : 181.9. Maleic anhydride Value : 16.9 Molecular Weight : 1030. Refractive Index : 1,4675, at 40°C.

234. Utilisation of Sambhar Lake Bitterns.

M. A. JOSHI and C. R. TALPADE, Poona.

The application of the Solvay Ammonia process has been suggested as a method for the utilisation of Sambhar Lake Bitterns. Typical analyses of the Bitterns have been cited. Results showing comparison of the carbonation of ammoniated Sodium Chloride and sodium sulphate under identical conditions are given in two tables. Further work is in progress.

235. Preparation of Insecticides and Fungicides from low grade Shark Liver Oil.

Miss K. PANKAJAKSHI AMMA, Trivandrum.

About 40 % of the shark liver oil extracted in the Government Shark Liver Oil Factory, Trivandrum, is of low vitamin potency and hence seldom used medicinally. This oil is now put to no other use than for the caulking of boats by fishermen. For the economic utilisation of the oil, it was converted into a range of probable insecticides and fungicides by halogenation and mercuration of the hydrocarbons obtained from the oil The oil was coverted into hydrocarbons by first cracking and then distilling with a suitable metallic catalyst. Chlorination of the hydrocarbons was effected under different conditions—without carriers at room temperature, at 100°C. and in direct sunlight and under the same conditions with iodine, sulphur and aluminium chloride as carriers. Bromination and mercuration of the hydrocarbons were also effected by usual methods. Insecticidal tests were made with these compounds and the results obtained were quite promising.

236. Travancore Eucalyptus Oil.

K. N. G. NAIR and N. S. VARIER, Trivandrum.

The leavest of the Eucalyptus trees (Species not identified)' growing near Trivandrum have been found to give an oil (Yield 0.86 per cent), having the following constants.

Sp. gravity (30°C) 0.8776 ; Ref. Index (30°C) 1.4689 ; Sp. rotation 20° 14′ ; Acid value 0.16 ; Saponification value 6.53 ; Ester value 6.37 ; and Saponification value after acetylation 98.0.

The oil has been fractionally distilled and found to contain Penine (about 60 %), Cineol (28 %) traces of terpineol (?). The last fraction also gives a positive test for aromadendrene.

237. Studies in the tube well waters in the coastal areas of Travancore. Part I. Tube we.ls at Veli.

P. G. N. PILLAY, T. K. P. KAIMAL and C. J. PHILIP, Trivandrum.

Fifteen samples of water from six bore wells at Veli were collected and analysed. From the alkalinity, chloride and hardness (1) of these samples it is observed that samples 2-11 belong to class I according to the classification of Chase Palmer (2) and the other 5 belong to classs III. Samples 3 and 4 collected from well No. 1 and sample 12 collected from well No. 4 are very high in chloride content and hence unfit for all domestic purposes. These are samples from a depth of 140′ below ground level. The effect of infiltration of sea water is observed at depth below 140′. The same effect was observed by the authors in the trial borings at Arattuquzha and Chavara about fifty miles north of Veli.

From the above observations and from these studies on the samples from other sources the authors have concluded that good drinking water could be supplied to the people living in the coastal areas of Travancore, from bore wells sunk to suitable depths so as to avoid the effect of infiltration of sea water.

References :—

(1) Standard methods of water analysis. Am. Water Works Association

(2) Chase Palmer, Geochemical interpretation of Water Analysis. U. S. G. S. Bull., No. 479, (1911).

238. Fossils of Kuttanad..

P. S. MAHADEVAN and C. S. BHASKARAN NAIR, Trivandrum.

The Kari lands of Travancore cover an area of approximately eighty square miles and are characterised by their low lying location and infertile nature. In these lands, large amounts of partially decomposed woody matter occur. The fossils have a fairly high sulphur content (2 to 3 %) and the high acidity in these areas has been ascribed to a part of the sulphur having been oxidised to sulphuric acid in presence of sulphur bacteria. The acid thus liberated besides being harmful to plant growth, solubilise iron and aluminium thus enhancing the toxic effect.

Distillation of the fossils gave water 27.8 %, tarry distillate 9.5 % uncondensed gas 5.7 % consisting of 55 % H_2S, and pitch 55.0 %. The tarry distillates were separated into acids, bases, phenols and neutral compounds by suitable extraction treatment. It furnished acids—1.72 % to 1.98 % ; Bases 1.99—2.30 % ; Phenols 64.1 to 65.01 % and Neutrals 30.98 to 31.82 %.

Further work on the identification of each of these fractions is in progress.

239. Travancore Marine Oils : Green Turtle Oil. Part I. Effect of certain phenolic substances on the stability of Turtle Oil.

E. JOHN JACOB, and T. A. RAMAKRISHNAN.

The action of antioxidant is specific to a large extent and it is important to study the effect of possible antioxidant on turtle oil. The antioxygenic action of hydroquinone, pyrogallol, pyrocatechol, quinhydrone and α -naphthol on the oil has been examined. Hydroquinone has got good action in retarding the development of rancidity on the oil.

240. Part II. Effect of gallic acid derivatives on the development of rancidity of Turtle Oil.

E. JOHAN JACOB and T. A. RAMAKRISHNAN (Trivandrum).

The remarkable inhibitory action of gallic acid derivatives on turtle oil has been investigated. The action of ethyl gallate, n-propyl gallate and gallanilide has been studied. Gallanilide has been found to have astonishing action in slowing down the development of rancidity.

241. Travancore Marine Oils—Green Turtle Oil. Deodorisation of Turtle Oil. Part I. Selective Hydrogenation.

E. JOHN JACOB and T. A. RAMAKRISHNAN, Trivandrum.

Selective hydrogenation has been found to be a valuable tool for preparing odour-free Turtle oil without detriment to its therapeutic action. Platinum, Palladium, Nickel on kieselguhr and Raney Nickel have been used as catalysts under different conditions. Raney Nickel in 0.4 % at 120°C is a good catalyst for deodorisation of the oil.

242. Studies in the Tube Well Waters in the Coastal Areas of Travancore, Part I. "Tube Wells at Veli."

P. G. N. PILLAY, T. K. P. KAIMAL and C. J. PHILIP, Trivandrum.

Samples of Water from the six bore wells at different depths were collected and examined.

243. Studies in the Preparation of Photographic Plates.

D. R. DHINGRA and M. G. GUPTA, Kanpur.

There does not exist a single concern in India which manufactures photographic plates. Preliminary investigations on the subject were done in our country by N. Kashinathan (Bull. Indian Ind. Res. 1937, No. 4) but the fastest plate prepared by him corresponded to a speed of 151 H. D. only. This is a very slow speed for commercial practice. J. V. Karandikar's work (Jr. Sci, Ind. Res., India, April 1943, **1**,**167—169**) was mainly centred in the preparation of emulsions while some other papers published prior to Kashinathan's work dealt simply with the possibility of manufacture without mentioning any experimental details.

The present paper deals with the exhaustive research work carried out by the authors who have succeeded in attaining a speed of 800 H. D. both with the orthochromatic and Panchromatic plates by using a suitable sensitiser out of a large number of sensitisers tried for the purpose. This aspect of colour-sensitisation was badly neglected by the previous workers. A new indication for determining the suitability of photographic gelatin, i.e., setting point has been added besides those existing limits for ash-content and water absorption. The optimum conditions of temperature and humidity for efficient drying of the coated plates have been found to be 16—20°C and 50—60 % respectively ; while for setting a temperature of 5—6°C has been recommended. Compositions of typical successful fast and slow emulsions along with the details of substratum coating and final additions of alcohol and colour-sensitiser have also been given in detail.

To increase the range of sensitivity, contrast and speed of the plates, besides finding out the optimum temperature and time of digestion and ripening, a number of colour-sensitisers in varying proportions have been tried. By the addition of 0.001—0.002 % of 2 : 6-Di- (p-diethyl amino)—styryl pyridine methiodide a speed of 800 H. D. has been obtained both with orthochromatic and panchromatic plates.

244. A New Process for the Preparation of chemical Gold-thread.

D. R. DHINGRA and M. G. GUPTA, Kanpur.

The main centres of production of Gold-thread are Banaras and Surat although there are a few factories at Bangalore, Poona Jullundur, Delhi, Ajmer, etc. This is one of the very important cottage industries of India and according to the Indian Tariff Board Report of 1948 the total production of gold and silver thread and allied products will be about Rs. 10 crores per annum, the total number of workers employed in the industry will be 40,000—45,000 and the capital employed will be about Rs. 3½ crores in Banaras and Surat only. Out of this the estimated value of the production at Banaras alone is nearly Rs. 3 crores yearly and about 10,000 workers are engaged in the industry.

For manufacturing gold-thread, very finely drawn silver wire (1200-3000 yds/ oz.) is first flattened and then wrapped mechanically over coloured cotton or art-silk thread. The silver-thread thus obtained is given a gold shade by either of the following three processes:—

(A) Electroplating with gold using hot cyanide bath.

(B) Dyeing in a solution of methylated spirit, shellac and a suitable phosphine dye.

(C) Colouring in a hot alkaline aqueous bath containing a dye Auramine 0-137 or OS. The gold—thread manufactured by the first process (A) is known as real gold-thread while that produced by the other two processes is called chemical gold-thread. It may be mentioned that the electroplating process is most expensive and least practised ; while the spirit colouring process (B) leaves behind a bad odour of methylated spirit and shellac in the finished product.

As a result of investigations carried out in the General Research Section of the Harcourt Butler Technological Institute, Kanpur, a new continuous process for the preparation of chemical gold-thread has been evolved by the authors, its optimum conditions determined and a laboratory scale apparatus has been designed. This process utilises a cellulose-nitrate lacquer bath in combination with suitable plasticiser, amyl-acetate soluble red and yellow dyes and a suitable blend of solvents. The composition of the bath is as follows :—

(1) Clear nitro-cellulose lacquer (sp. gr. 0.888 to 0.889 at 25°C; Nitrogen content of Nitro-Cellulose 10.2—10.5 % -- -- -- = 3000 parts by wt.
(2) Plasticiser like Bedesol—785 from I.C.I. -- = 80 ,, ,,
(3) Colours from I.C.I. (Waxoline Yellow (OS). -- = 20 ,, ,,
(Waxoline Yellow (IS) -- = 8 ,, ,,
(4) Solvents. (N-Butyl Alcohol (B. P. 116°C) -- = 400 c.c.
(Amyl acetate (B. P. 148°C) -- = 300 c.c.
(Acetone (B. P. = 56°C) -- = 300 c.c.

The sp. gr. of the final bath may vary from 0.890-0.895 at 25°C depending on the desired shade and it would cost approximately Rs. 35/- per gallon.

The samples of chemical-gold-thread prepared by this method compare favourably in shade with the best Banaras and Surat samples as indicated by the tintorial readings, have better lusture and light fastness properties and are completely free from any undesirable odour as hitherto affiliated with the spirit colouring process.

The process has been recently communicated to the Banaras manufacturers.

245. Studies in the preparation of Photographic Printing Papers.

D. R. DHINGRA, M. G. GUPTA and GIRISH C. JOSHI, Kanpur.

The literature on the subject is very scanty and mentions only the general principles of emulsion technique. The process is a closely guarded secret of the foreign firms and is covered by patent rights. A few papers published in India on the preparation of photographic printing papers by Radha Raman Kher, (Jr. and Proc. Inst. Chem., 1933, **4**, 13-18); H. Das Gupta and H. K. Sen (Jr. and Proc. Inst. Chem., 1935, VII, 73); J. V. Karandikar (Jr. Sci. Ind. Res; 1, Prinl 1943, 167-169), etc., deal either with possibility of manufacture or the preparation of emulsions. The details are missing.

As yet there is not a single factory in India producing photographic printing papers although there is a huge consumption of the same.

The authors have carried out detailed investigations on the preparation if both gas-light and bromide printing papers utilising both Indian and foreign base papers. The optimum conditions as regards temperature and humidity, suitablity of photographic base papers, photographic gelatin, suitable substratum, baryta coating, composition of the emulsion etc., have been arrived at. It has been concluded that the photographic base papers must be free from wood-fibres and metallic specks; the optimum conditions for the drying temperature and relative humidity should be 16-20°C and 50-60% respectively and the photographic gelatin must have a setting point range of 18°-20°C and its ash percentage should not exceed 2%. The compositions and the details of the preparation of some of the most sensitive emulsions have also been given. The samples prepared have been compared with the foreign papers by exposing them to film and plate negatives under identical conditions and have been found to compare well.

The authors have, however remarked that the main difficulty lies in the non-availability of the photographic base paper. Our Indian paper mills are not in a position to produce the same due to lack of suitable machinery; while the foreign concerns are not willing to supply the same due to a heavy demand in their own countries.

246 Investigations on the Manufacture of Coal-Ash-Lime Bricks.

I. A. SIDDIQI and B. S. R. SASTRY,

Ultimate chemical analysis and sieve analysis of coal ash obtained as a boiler waste was made. Mixture containing suitable proportions of the former in appropriate size fractions with varying proportions of lime and water was moulded into briquettes and autoclaved under a steam pressure of 120 lbs./sq. in. for 6 hours. The resulting bricks possessed a high compressive strength besides other physical properties characteristic of high class building bricks. Between certain limits increasing proportions of lime were found to increase the compressive strength of the bricks.

247. Sugar Cane-wax. Part I. Its purification and properties.

Y. P. KAPIL and S. MUKHERJEE.

Crude wax as obtained by Solvent Extraction has very dark colour, soft, with high ash content and objectionable odour.

To make it suitable for manufacture of high grade leather polishes and printing ink etc. and to use it as substitute of Carnauba wax which is mainly imported from outside the wax should be subjected to purification.

Crude wax containing about 3% ash was de-ashed by Hyrochloric Acid and then de-fatted by melting it and pouring it under vigorous stirring in 3 parts of Ethanol (96%) and maintained at a temperature of 25°C. The above process was repeated second time. Recovery of hard wax was about 70%. Acetone was also used for defatting in place of alcohol but the solvent loss was found to be much more and product obtained was very similar to that obtained by alcoholic precipitation.

Refined wax was bleached by $KCLO_3$ (10%) and sulphuric Acid 10%. Wax obtained was of yellow colour and very hard and have the following analysis:—

M. P.	Sp. Gr.	Ash %	Sap. Value.	Iodine value.
77°—78.5°C	.98	0.1	80.9	15.2

Crude wax has the folowing analysis.

M. P.	Sp. Gr.	Ash %	Sap. value.	Iodine value.
65°—70°C	.96	2.9	68.8	66.0

248. Provincial Industrial Research Laboratory.

S. M. PRASAD, Patna.

During the process of making gas from Kerosene some tar is produced in various technical institutions. It generally goes to waste. A study is being made of three samples of such tars. Distillation datas are given for three samples of tars and of yellow Kerosene which is used for making gas. The tars contain appreciable amount of light oil. The yellow Kerosene and distillate from the three tar samples have been analysed for unsaturated, aromatic, naphthenic and paraffinic hydrocarbon contents. During cracking aromatisation takes place and the distillates contaiin as much as 84.6% of aromatic. The possibility of utilising the tars for various purposes are being studied.

249. Control of aquatic vegetation with Dicotox.

R. SRINIVASAN and P. I. CHACKO, Madras.

By conducting a series of laboratory and field experiments it is concluded that (1) Dictotox, a self-emulsifying formulation of the May and Bakers (India) Ltd., containing the ethyl ester of the 2, 4-D, is able to kill submerged weeds like **Hydrilla ...verticellata,** and **Najas graminea,** and rooted plants like **Vallisneria spiralis** and **Nymphaea rubra;** (2) a dose of 1 oz. per 100 sq. ft. of Dicotox kills the above-mentioned aquatic plants in about 20 days; (3) a dose of 2 oz. per 100 sq. ft. of Dicotox, administered in three equal instalments at intervals of seven days kills the aquatics in about 16 days; (4) both the doses specified above are not harmful, either directly or indirectly, to freshwater fishes like **Catla catla, Labeo fimbriatus, Cirrhina reba** and **Barbus sarana;** (5) there is an increase in the density of freshwater biota of the pond treated with Dicotox from the fourth day on wards; and (6) the cost of Dicotox required to kill the water plants in about twenty days is Rs. 92-8-0 per acre.

250. Studies in Soil Permeability II. The effect of ageing of the dehydrated soil on its Permeability.

K. SUBBA RAO and S. K. WADHAWAN, New Delhi.

Soil Dehydrated at 800°C was subjected to Permeability study at different intervals of time after dehydration. The 1-day, 2-day, 3-day and 7-day old samples have shown very marked differences in Permeabilities i.e. the initial value, subsequent maximum and the final trend. For example, the maxima of the different samples are approximately 300 c.c., 400 c.c., 130 c.c. and 210 c.c. respectively. The differences in Permeability of the soil samples brought about by ageing are very prominent indeed, though the cause of this variation is still obscure. Further work is still in progress on this interesting effect.

251. Studies in Soil Permeability I. The effect of temperature of dehydration of the soil on its Permeability.

K. SUBBA RAO and S. K. WADHAWAN, New Delhi.

The Problem of the Permeability of soil for water is of great importance in Engineering Practice and has been extensively studied by various investigators. The effect of the temperature of dehydration of the soil on its Permeability is studied and is presented in this paper. The Delhi soil was dehydrated at the following temperatures 60°C, 105°C, 200°C, 225°C, 260°C 350°C, 800°C. The permeability of the dehydrated soil was determined in a permeameter tube with constant water level arrangement. The variation in permeability of the soil under prolonged submergence of soil under water was studied. The following are the noteworthy features.

(1) The initial Permeability of the soil increases progressively with increase in Temperature.

(2) The initial decrease and the subsequent minimum in permeability which are exhibited by normal soils are not exhibited by soil samples dehydrated at 260°C and above.

(3) The maximum exhibited in each of the soil samples dehydrated at different temperatures also undergoes a progressive increase with the temperature of dehydration.

The progressive increase in the Permeability of the soil with increase in the temperature of dhydration is probably due to the decrease in the hydration capacity of the soil.

252. Refining of shaal seed fat.

D. MISHRA, Sambalpore.

Orissa is rich in Shaal trees, nearly, 1,700,000 in number. The annual production of Shaal seed is approximately 450,000 maunds. Only 2% of it is utilised in manufacturing oil and the rest is wasted in the forest. The fat is green in colour. This colour stands in the way of its utilsation mostly for edible purposes. This oil has been refined by the use of activated charcoal and Fullers' Earth under specified condition to be utilised for edible and other industrial purposes.

253. Rate of Settling of Commercial Lime Suspensions. Part I.—Effect of the Amount of Water Used for Hydration.

P. R. BAVDEKAR, B. R. WALAVALKAR and R. P. DAROGA (Mithapur), Saurashtra.

Three samples of commercial lime were hydrated using different quantities of water and diluted with more water to give milks of the same strength. These suspension were then studied for their settling characteristics. The quantity of water used for hydration varied from the theoretical amount to ten times this quantity. From the results obtained no definite relation could be established between the amount of water used for hydration and the rate of settling. In some cases the slowest settling suspension was the one where the water for hydration was 1.5 or 2 times the theoretical quantity while in other it was with 6 or 10 times water that the rate of settling was the least.

The volume of the settled hydrate—the sedimentation volume—was also affected by the amount of water used for hydration. In almost all cases it was found that where less water (upto twice the theoretical quantity) was used for hydration the volume of the sludge was larger than when more than four times the theoretical quantity of water was used.

The results are discussed on the basis of the theory of floc formation and the mechanics of sedimentation.

254. Rate of Settling of Commercial Lime Suspensions. Part III. Effect of Particle Size of Lime.

P. R. BAVDEKAR, B. R. WALAVALKAR and R. P. DAROGA (Mithapur), Saurashtra.

Earlier workers have published conflicting results on this subject. Experimental evidence has been recorded on the effect of particle size of two commercial lime samples on the rate of settling of the suspensions of their hydrates. The two samples were ground and sieved and the various portions according to the average particle size were hydrated separately under identical experimental conditions. The resulting hydrated lime samples were mixed with sufficient water to give milks of the same strength and their settling properties studied.

The changes in the rate of settling due to the variations in the particle size of lime do not seem to be regular. All particles retained on a 150-mesh sieve seem to be having about the same settling rate. The only exception is the portion passing through the 150-mesh sieve; this sample alone gives a hydrate which settles much more slowly than the rest.

255. Behaviour of certain edible oils in the Frying Pan.

T. N. MEHTA, C. V. N. RAO and P. SEN, Nagpur.

Large quantities of fats and oils are used in the frying of various foodstuffs in public and household cooking. The usual practice followed in hotels and sometime at home is that the same fat is used over and over again for frying. Some physical and chemical changes in fats used for cooking are here in reported.

The frying was carried out at a temperature of 190—200°C in groundnut oil, hydrogenated fat, coconut oil and refined coconut oil. The colour, acid value, iodine value, refractive index, saponification value and peroxide value have been determined before and after successive frying of the above oils. The colour improves in the beginning in the case of groundnut oil. The peroxide value in case of groundnut oil is higher than in the case of hydrogenated oil and in the case of both it increases on recurrent use. The iodine values drop in the case of both groundnut and hydrogenated product. In the case of coconut oil the acid value is greater than that of the refined coconut oil, but in the raw coconut oil the acid value drops while in refined coconut oil it slightly increases. The iodine values of both coconut oils slighting decrease on successive frying. In conclusion, it may be observed that in certain respects the raw oil improves on frying and judged only from the analytical characteristics, the natural vegetable oils are not less satisfactory than solid fats, but the palatibility taste and odour of the fried materials are better in the case of hydrogenated fat and refined coconut oil than in the case of raw oils.

256. Extraction of Protein from Mustard Seed Oil Cake.

T. N. MEHTA and B. R. KAPOOR, Nagpur.

The utilization of vegetable proteins in the manufacture of fibres, films, adhesives, paper and textile sizes, cold water paints have assumed recognition in the U. S. A. and the large amount of work has been carried out by Arthur and his co-workers at the Southern Regional Research Laboratory (J. Amer. Oil Chem. Soc. 1948, **25**, 99, 338, 398, 1949, **26**, 147). One of the authors (T. N. Mehta(, previously studied the extraction of protein from oil free cake-meal of groundnut, gingelly, linseed, castor and Mowrah Oils Kodangekar, Mandlekar and Mehta, J. Ind. Chem. Soc. Ind. and News Ed. 1946, 9, 35). In the present work the oil cake of Mustard seed obtained after the extraction of oil in an electric driven Kohlu was used. The oil cake was reduced in size in Christy Norris disintegrator and the product passed through a 1/64″ standard sieve. The analysis of this crushed cake is as follows:—moisture 7.2%, oil 9.1%, ash 7.0%, phosphorous 1.3% and protein 36%. The oil-content of the cake was removed by treatment with light fraction of petroleum (below 80°) in a soxhlet apparatus. The analysis of the oil-free cake was: ash 6% and protein 42%. The experiments were conducted to peptize the protein with varying percentages of sodium hydroxide, sodium sulphite and sodium chloride solution. With a meal to solvent ratio of 1 to 40 and two successive extractions, the maximum peptization of protein obtained with.05 concentration of solvent was 38% with sodium chloride, 33% with sodium sulphite and 11.98% with caustic soda.

---

257. Estimation of Silver by Selenious Acid.

G. S. DESHMUKH and K. M. SANKARANARAYANAN, Benares.

The gravimetric estimatioon of silver as silver chloride suffers from the disadvantage that the precipitate is susceptible to decomposition by light and also that its rapid volatility does not permit its conversion to metallic silver quantitatively. The determination of silver as silver selenite was therefore studied by precipitating the silver as silver selenite with aqueous selenious acid from neutral silver nitrate solution.

Three different procedures were adopted:—

(i) The precipitate was filtered through a sintered glass crucible, washed free of selenious acid, dried at 100°C and weighed.

(ii) Silver selenite was filtered through Whatmen No. 42, washed thoroughly, dried and decomposed by gentle heating in a porcelain crucible to metallic silver.

(iii) Excess of silver nitrate was taken to which an aliquot quantity of selenious acid of known strength was added. The precipitated silver selenite was filtered and the excess of silver nitrate was determined by the Volhard's method.

The accuracy of the results compare favourably with those obtained by the classical methods of Mohr and Volhard,

258. Estimation of Selenious acid by Mercuric Nitrate.

G. S. DESHMUKH and K. M. SANKARANARAYANAN, Benares.

Results are given for the estimation of selenious acid by mercuric nitrate. Selenious acid is precipitated by adding excess of mercuric nitrate to an aliquot quantity of aqueous selenious acid solution. The precipitate is filtered through a sintered glass crucible, washed, dried at 100°C and weighed. The filtrate contains the excess of mercuric nitrate which is titrated against standard KCNS using ferric nitrate as the indicator, the strength of the selenious acid or selenium content of the same is calculated from the weight of the mercuric selenite or from the knowledge of the unreacted mercuric nitrate determined by back titration.

The results are in good agreement with those obtained by a direct iodometric determination of selenium in selenious acid.

259. Determination of Selenious Acid by Thiourea.

G. S. DESHMUKH and K. M. SANKARANARAYANAN, Benares.

The adaptability of the qualitative test for the micro detection of Selenium by thiourea for its gravimetric estimation has been studied. Metallic selenium precipitated from selenious acid by excess of thiourea is filtered through a gooch-crucible with an asbestos bed, washed, dried at 100°C and weighed. The results are in accord with those observed in the standard iodometric procedure for selenium determination. Back titration of excess of thiourea has not been so far successful due probably to the interference by the formation of formamidine disulphide as a product of the reaction.

260. On the Solubility of Ce, La asd Th Oxalates in Sulphuric Acid.

G. S. DESHMUKH and K. M. SANKARANARAYANAN, Benares.

Earlier work (Hauser and Wirth, Z. anal. chem. 47, 389, 1908 and E. Rambach and A. Schubert, Z. phys. chem. 67, 183, 1909) reported the determination of the solubility of Th, Ce, La and other rare oxalates in sulphuric acid, ammonium oxalate and mixtures of sulphuric acid and oxalic acid of various concentrations at 25°C. Data are now given for the solubility of Th, Ce, La oxalates at 20, 30, 35, 40 and 45°C in sulphuric acid of different concentrations varied over a range of 0.5 to 4.0N. The results are compared with those observed by Hauser and co-workers.

261. Analytical Chemistry of Thorium. Part V. Estimatios by O-phemetidine and O-anisidine.

G. S. DESHMUKH and J. XAVIER, Benares.

It has been observed that the adaptability of O-tolidine, dianisidine and p-phenylene diamine in the determination of thorium is restricted due to the co-precipitation of cerium and other rare earths. Further observations were therefore carried out to investigate the use of other amine and bases as specific reagents for thorium. Results so far obtained show that O-phenetidine and O-anisidine separate thorium quantitatively from its 50% alcoholic solution containing an almost equivalent amount of trivalent cerium.

Further work on the development of these procedures is in progress.

262. Analytical Chemistry of Thorium. Part IV. Estimation by O-tolidine, dianisidine and p-phenylene diamine.

G. S. DESHMUKH and J. XAVIER, Benares.

Jefferson (J. Am. Chem. Soc. **24**, 540, 1902) and Hartwell (J. Am. Chem. Soc. **25**, 1128, 1903) reported the use of various amines for the quantitative determination of thorium. These observations have been extended to O-tolidine, dianisidine and p-phenylene diamine to investigate their utility in the quantitative precipitation of thorium. Saturated alcoholic solutions of these amines precipitate thorium from its solution containing 50% alcohol in a PH range 5—6. ThO_2 obtained by igniting the precipitates to constant weight corresponds to that present in the aliquot quantity of the original solution taken for estimation.

263. Analytical Chemistry of Thorium. Part III. Estimation by pyrogallic acid.

G. S. DESHMUKH and J. XAVIER, Benares.

A freshly prepared solution of pyrogallic acid in air-free water precipitates thorium quantitatively from its solutions in a pH range 5.2-6 adjusted by ammonium acetate. After the addition of the precipitant the solution is allowed to stand for about 6 hours, or is heated to 80°C and kept aside for two to three hours. The precipitate is filtered, washed with air-free water and ignited to constant weight as ThO_2. The reagent is, however, not useful for the separation of thorium from the other familar congeners.

264. Analytical Chemistry of Thorium. Part II. Estimation by stearic acid.

G. S. DESHMUKH and J. XAVIER, Benares.

Precipitation of thorium from aqueous thorium chloride or nitrate by saturated alcoholic solutions of stearic and palmitic acids has been studied. The precipitate is ignited and thorium is estimated gravimetrically as ThO_2. With stearic acid as a precipitant quantitative results have been obtained from the solution maintained in a pH range of 5—6. Corresponding results with palmitic acid have not so far been found accurate and reproducible.

265. Analytical Chemistry of Thorium. Part I. Estimation by m-hydroxy benzoic acid.

G. S. DESHMUKH and J. XAVIER, Benares.

Thorium is quantitatively precipitated from its salt solution by m-hydroxy benzoic acid. The pH of the medium is adjusted between 4-5.5 by the addition of sodium acetate. The solution is boiled for about thirty minutes after the addition of the precipitant and the precipitate is ignited and weighed as ThO_2. Under comparative conditions trivalent cerium is not precipitated, and therefore does not cause any interference. The determination of the limit of accuracy and the influence of other rare earths in the estimation of thorium by the above procedure is under investigation.

266. On the Solubility of Rare Earth Hydroxides in Aqueous Sodium Potassium Tartrate.

G. S. DESHMUKH and K. V. NAYAK, Benares.

Data are given for the solubility of Ce^{iii}, La, Ce^{iv}, Er and Yttrium hydroxides in Rochelle salt solution of varying concentration upto 30%. Whilst in general, the solubility of cerous hydroxide is more than lanthanum, that of Ce^{iv}, Er and Yttrium hydroxides are negligibly small even in 30% rochelle solution. The critical concentration limit of the solvent where the solubility of cerous and lanthanum hydroxide increases abruptly is found to be 12.5 and 20% respectively. The possibility of a fractional separation if Ce from La and of both these rare earths from Er and Y by the above procedure is suggested. Further work on the behaviour of other rare earth hydroxides under identical experimental conditions is under progress.

267. Estimation of Selenious Acid by As_2O_3.

G. S. DESHMUKH and B. R. SANT, Benares.

A volumetric method has been evolved for the estimation of selenious acid by arsenious oxide. Selenious acid liberates iodine quantitatively from KI or NaI in acid medium. This iodine is titrated at a pH adjusted between 6.5 and 7 against standard arsenious oxide solution, using starch as the indnicator. The results obtained are comparable with the classical iodometric procedure involving the use of sodium thiosulphate. Various experimental conditions, and the application of this method for the estimation of metal ions forming insoluble selenites is under investigation.

268. Arsenious Oxide—a Primary Standard for the Determination of Copper.

G. S. DESHMUKH and B. R. SANT, Benares.

A new iodometric method for the determination of copper has been evolved. Aqueous copper solutions can be used directly. In case of acid solutions, pH is adjusted between 6.5 and 7 by first neutralizing the acidity by ammonia or sodium bicarbonate and then few drops of acetic acid followed by sodium acetate-acetic acid buffer. Potassium or sodium iodide is added and the liberated iodine is titrated against standard arsenious oxide solution. The results are in good aagreement with the standard iodometric method using thiosulphate. Furthermore, the method offers two distinct advantages over the classical iodometric procedure, (a) small quantities of copper can be determined in dilute solutions and (b) arsenious oxide can be used directly as a primary stanndard.

269. Determination of Elementary Red Phosphorus by Potassium Bromate.

G. S. DESHMUKH and B. R. SANT, Benares.

A new titrimetric method for the determination of elementary red phosphorus is developed. Pure red phosphorus is refluxed with excess of standard potassium bromate solution acidified with sulphuric acid. The excess of $KBrO_3$ is back titrated iodometrically after the whole of phosphorus is converted into phosphoric acid. The acidity of the system is an important determinant of the accuracy of the method and is maintained at or about 0.5N. The procedure is comparatively more simple, rapid and accurate than the one involving the use of KIO_3 as an oxidant for phosphorus.

270. Arsenophosphotungstic Acid—A Micro Reagent for Cerium.

G. S. DESHMUKH, Benares.

Observations on the detection of small quantities of cerium in qualitative analysis have led to the development of an almost specific micro-analytical test for its trivalent salt by arsenophosphotungstic acid (Benidict's reagent). The determination of the concentration and identification limits showed that cerous ions in as small a quantity as 0.5 Y in one drop can be detected easily with this test. Cu, Cr and V interfere with the test. The interference due to some of the difficulty available rare earths is being investigated.

271. Estimation of Phosphorus by Ceric Sulphate.

G. S. DESHMUKH, Benares.

A new titrimetric method for the estimation of elementary (red) phosphorus based on its oxidation by ceric sulphate has been developed. Under the given experimental conditions phosphorus is oxidised quantitatively to phosphoric acid and the excess of ceric sulphate left over after the completion of this oxidation process is back titrated with standard ferrous ammonium sulphate using ferroin as the indicator. The applicability of this procedure to the determination of the solubility of phosphorus in various solvents is under investigation.

272. Studies on differential thermal analysis of catalyst powders. Part I. The differential thermal analysis of precipitated oxides of iron, aluminium and nickel.

S. K. BHATTACHARYYA and S. N. GOPALASWAMY, Bangalore.

Differential thermal analysis as a research tool for the study of structural changes in solid catalysts when they are subjected to heat treament has rarely been made use of. The analysis may, in many cases, provide valuable information as an aid in elucidating the mechanism of catalytic reactions.

Differential thermal analyses for precipitated oxides of iron, aluminium and nickel which are employed as catalysts for a number of reactions were carried out. The iron oxide precipitated from a nitrate solution by means of ammonium hydroxide gave an endothermic peak at 165° and an exothermic peak at 260°C. Aluminium oxides prepared by different methods, eg. by the action of ammonia on aluminium nitrate, sodium hydroxide on aluminium nitrate and carbon dioxide on potassium aluminate, had similar thermal properties and gave an endothermic peak at about 300°C. The nickel oxide precipitated by sodium hydroxide from a nitrate solution showed a thermal peak at 300°C. Attempts are being made to correlate these data with the temperatures at which maximum catalytic activity of the catalysts has been observed.

273. A new method for the simultaneous determination of Arsenic and Sulphur in Organo-arsenicals.

AKHIL CHANDRA ROY, Bangalore.

While studying the synthesis of a number of chemotherapeutically active arsenicals, most of which containing sulphur, a method for the simultaneous determination of arsenic and sulphur has been established. The organic compounds containing arsenic and sulphur are preliminarily oxidised by alkaline permanganate and the oxidation is finally completed by the same reagent in presence of acid. The arsenic pentoxide so formed is readily determined by treatment,in strong acid solution, with potassium iodide and titration of the liberated iodine with sodium thiosulphatt according to the equation

$$As_2O_5 + 4HI \rightleftarrows As_2O_3 + 2H_2O + 2I_2$$

The sulphur present at sulphate is estimated gravimetrically as barium sulphate The results obtained by this method compare very well with those obtained by older methods. When the reagents, apparatus, etc. are ready, a determination can easily be completed in 3-5 hours. As long as all the necessary precautionary measures are taken, a very large excess of permanganate has no influence on the accuracy of the result of arsenic estimation. The end point is usually very sharp.

274. The Technique of Paper Chromatography, its applications and physico-chemical aspects.

D. P. BURMA, Calcutta.

Paper chromatography as developed by Consdon, Gordon and Martin with a few modifications and developments has been applied to the solution of certain biological and purely chemical problems. A reference to the study of physico-chemimal aspects of the technique, which preceeded the above modifications has also been made.

275. On the determination of Thiamine Hydrochloride.

SUKHAMOY BHATTACHARYA and SURESH CHANDRA BANERJEE, Calcutta.

Various methods have been suggested for the determination of thiamine hydrochloride in solution. For a quick estimation the excess of potassium ferri cyanide after the oxidation of thiamine hydrochloride to thiochrome in alkaline medium has been suggested to be determined iodometrically (**cf.**, Basu and Ray, J. & Proc. Inst. Chem., 1947, 19, 74 and Ray, ibid, 1948, 20 144). But this method has been found to give varying results in different parts of the year and it seems that the temperature and time of reaction play an important role in this procedure. As such this ferricyanide method and the alkaline hypoiodite method have been thoroughly studied so as to find out the conditions suitable for the estimation of thiamine hydrochloride in solution.

The results show that thiamine hydrochloride may be determined by the ferricyanide method using potassium iodide solution alone as well as that with zinc sulphate and sodium chloride. The reaction time requires to be varied along with the temperature at which the reaction is conducted. The hypoiodite method may also be successfully applied using 2 c.c. of 0.02 N iodine solution and allowing the reaction to be continued for 30 minutes.

276. Table for finding the weight per gallon of spirit by Sike's A Hydrometer for "Indications" 0.0 to 6.6.

Dr. S. K. CHATTERJI and SRI S. SEN GUPTA, Calcutta.

Rectified spirit and other spirit are sent out in Casks, from Distilleries to Warehouses or Bonded Laboratories, where the quantity of spirit in each cask has to be checked with the help of Sike's glass hydrometer and "A" glass hydrometer; from the "indications" noted and on referring to the data on the "Spirit Tables' the weight of a gallon of spirit in pound is determined. The net weight of the spirit in the cask divided by the weight of the spirit per gallon thus determined would give the quantity of spirit in the cask in gallons. The figures in the "Spirit Tables" referred to above are the gravity figures relative to water (10 lbs.) at 60°F. The 'indication" by Sike's "A hydrometer for absolute alcohol at 60°F is 6.6 and so the table starts with the figures showing weight in pounds per gallon of spirit at that "indication" and no figures are shown against indication lower than 6.6. With the latest improvement in stills it is possible to distil spirits at a strength as high as 97 to 98% by Volume and the "indication" of such spirits ranges between 3 and 4 at a temperature 90°F-95°F (average temperature in a tropical country like India). A table has been compiled showing the weight in pounds per gallon of spirit for "indications" between the range 0.0 to 6.6 of Sike's 'A' hydrometer at 5 different temperatures between 70°F and 90°F thus covering the remaining lower range of "indications" for which no figures are given in the "Spirit Tables.'

277. Paper Chromatography of inorganic cations.

N. C. SEN GUPTA and G. N. PHUKAN, Digboi.

Partition chromatography of cations on filter paper has been studied using a number of organic solvents. Solvents which are completely or partly miscible with water can be used. When using solvents like ethyl alcohol, isopropyl alcohol, acetic acid or ketones, 10 cc. of normal HCl in water was added to 100 cc. of solvent. Partially miscible solvent like isobutyl alcohol were saturated with normal HCl. R_f values of second group cations were found to vary in the order: ethyl alcohol > isobutyl alcohol > acetic acid > isopropyl alcohol > methyl ethyl ketone. By the use of mixed solvents it is possible to alter R_f values as desired. Tailing of the solute is a drawback of this method which can be partly obviated using speiific reagents for the cations. Use of viscous material such as sugar solution or glycerine reduces the tailing.

Colloidal bentonite has a base-exchange capacity of the order of 1 m.e./gram. It cannot normally be used in column chromatography because of swelling. It can, however, be deposited on filter paper for ion exchange chromatography. Both sodium and hydrogen bentonites have been tried and preliminary experiments carried out with several polyvalent cations.

278. Chromatographic analysis of natural Petroleum.

N. C. SEN GUPTA and A. GUPTA, Digboi.

Natural petroleum consists of a large number of hydrocarbon compounds which can be structurally divided into four groups, namely, aromatic, olefinic, naphthenic and paraffinic. When petroleum diluted with a suitable solvent e.g. petroleum ether, is chromatographed on activated silica or alumina, aromatics are mostly strongly absorbed followed by olefins and cycloparaffins. Normal paraffins pass mostly into the filtrate. In each group again the adsorption increases with the molecular weight, so that aromatics of low molecular weight may be adsorbed together with big molecule of olefins and so on. Thus, a sharp separation of petroleum into the four groups cannot be made by chromatography alone. Nevertheless, it is possible to divide petroleum chromatographically into a number of fractions with physical properties which change gradually from fraction to fraction. Several adsorbents and eluents of increasing polarity have been used for this purpose. Amongst the properties of the eluates studied are refractive index, fluorescence in the ultraviolet light, density and aniline point. A discussion of the results with special reference to the practical limits of chromatographic separations as applied to petroleum technology has been presented.

279. Potentiometric Estimation of Cobalt and Nickel.

V. S. SUBRAHMANYAM and S. HUSAIN, Hyderabad-Deccan.

Various gravimetric and volumetric methods for the estimation of cobalt and nickel are well known. An attempt has been made by the authors to estimate these metals potentiometrically using Potassium sulphocyanide solution as a titrating agent in neutral solutions, when present singly or in a mixture of the two.

Sharp break in the fall of potential was observed when the amount of potassium suphocyanide added corresponded to KCNS : 1 Co^{++} (Ni^{++}). The results compared favourably with those obtained by gravimetric methods. The Potentiometric method is rapid and more sensitive.

In a mixture of Cobalt and Nickel KCNS first reacts with Cobalt and then with nickel. The solutions used in all cases were those of sulphates. Further work is in progress.

280. Potentiometric Titration of Synthetic Organic Cation-Exchanging Resins in Mixed Medium.

LALMOHON MUKHERJEE.

Potentiometry in aqueous medium often fails to detect groups like phenolic OH for marked inflections are dificult to obtain. However, potentiometric titrations of substances containing such weak spots carried out in a suitable protophilic mixed medium are very satisfactory in that these allow to detect and distinguish so weakly an acidic group as phenolic—OHs without difficulty.

For the present purpose, we investigated the systems viz. H_3PO_4 H_2SO_4, and three synthetic organic cation exchanging resins—Sulphonated phenol-formaldehyde, Phenol-formaldehyde and m—hydroxybenzoic acid-phenol—formaldehyde.

The medium used consisted of water, alcohol and aniline in 1: 1: 1 by volume.

281. Oxidation of Manganese with Red Lead.

Miss. P. V. SUBBALAKSHMI and G. R. PHANASALKAR.

In an effort to find a cheaper substitute for sodium bismuthate in the oxidation of manganese salts to permanganate, red lead was tried, and quantitative experiments were undertaken to find the efficiency of the same. A known quantity $MnCO_3$ was dissolved in HNO_3 and the manganese precipitated as MnO_2 with NH_4OH and Br_2. The precipitate of MnO_2 was treated with a known volume of conc. HNO_3 (2:1) and varying quantities of red lead, and the resulting permanganate estimated by three different methods, viz., titrimetrically with std. Oxalic acid and std. sodium arsenite, and colorimetrically. The maximum yield of permanganate obtained was 35%, when the ratio of Mn salt to red lead was 1:60. Varying quantities and concentrations of HNO_3 indicate that the oxidation to permanganate depends on the quantity of the acid present and is not much affected by its concentration. The maximum oxidation (25%) is obtained when the ratio of Mn salt to HNO_3 is 1 : 160. When HCl is used for dissolving the Mn salt, the oxidation to permanganate falls to 10%. This is in accordance with the observation due to (Mellor) that the (Cl′) chloride ions hinder the oxidation process.

282. Chromatography on Bleached Cane.

BINAYENDRA NATH SEN.

Experiments were performed to effect chromatographic separation of certain cations on bleached cane. Qualitative separation of Cu—Cd, As—Sb—Sn Cu—Fe have been effected.

283o Methods for Preparative Organic Work in the Micro Scale.

W. SCHOENIGER, GRAZ, Austria.

Simple, light, easily manufactured glass apparatus has been prepared for the preparatory organic work with substances of 1—2 grammes ; this is described with details of measurements. This glass apparatus can be adapted to all processes in which the organic chemist will need to use it, e.g. dissolving, stirring, condensing, crystallising, separating solids from liquids, distillation under normal and reduced pressure, fractional distillation, distillation with steam, extraction and sublimation. By this technique practically the same percentage of output can be achieved as formerly, when a greater amount of substances were used, and a great saving of time and material is gained.

The method in question is suitable first and foremost for the practical laboratory work of students of chemistry, and has already proved its worth in practice.

284. A New Volumetrical Method for the Determination of Co-Groups in the Micro Scale.

Prof. H. LIEB, W. SCHOENIGER, Graz, Austria.

Several methods for the determination of Co-groups in organic compounds are known. Only one was used in the micro scale. By this method the organic compound reacts with a known amount of phenylhydrazine hydrochloride. The excess of this is determined after oxidation with FEHLING-solution volumetrically.

A new procedure is presented, in which the compound reacts with 2, 4-dinitrophenylhydrazine. A great number of organic compounds reacts quantitatively with dinitrophenylhydrazine and gives insoluble hydrazones. For the determination 2—5 mg. of the substance are brought into solution and mixed with an excess of a known amount of a solution of 2, 4-dinitrophenylhydrazine. After separation of the dinitophenylhydrazone the excess of dinitrophenylhydrazine is reduced with titanous chloride under an inert atmosphere. The none-oxidised titanous chloride is titrated with 0.02 n-ferric ammonium sulfate by using ammonium thiocyanate as an indicator. A blank should be run on the titanous chloride for each set of reductions.

It is also possible to use p-nitrophenylhydrazine or 2, 4, 6-trinitrophenylhydrazine for substances which will not react quantitatively with 2, 4-dinitrophenylhydrazine.

285. Resonating Semipolar Single Bond Part Division of Reactions into one Electron and Two Electrons Transfer Types.

SAIYID SHAMIM AHMAD and KH. M. A. AZIZ, Aligarh.

There is a great deal of difference between the reactions of CO and C C. The substances which add to C C do not add to CO group and vice versa. It has been shown in this series that all the reactions of CO group are ionic in nature. It has also been shown in this series that C C react by semipolarisation of one bond out of two in the double bond and that all its reactions are with substances which have or can assume a resonating semipolar single bond. This division of reactions into double and single electron transfer types is easily seen to be quite a general one. A similar recognition of one electron transfer type has been proposed by Sheppnard in the chemistry of the ionic reactions.

286. Methyl Amine-Acetaldehyde Complex.

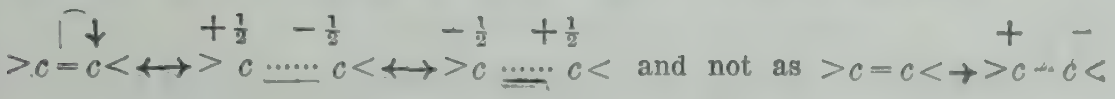
M. OMAR FAROOQ, AIYID SHAMIM AHMAD and MOHD. SHARIF, Aligarh.

During the course of the study of a proposed synthesis of ephedrine through the reaction of acetaldehyde, methyl-amine and benzyl alcohol it was considered necessary to study the methylamine acetaldehyde complex. No mention of this compound could be found in the literature. Methyl amine is reported to form Schiff's base with acetaldehyde. However, by working at low temperature (about —16°C) the complex was prepared by mixing the two liquids directly or in solution of various solvents. The substance is a colourless viscid liquid which on heating becomes coloured due to the formation of Schiff's base.

287. Resonating Semipolar Single Bond Part VII Reactions of the Double Bond (Olefines).

SAIYID SHAMIM AHMAD and HAMADUL HASAN—Aligarh.

The hypothesis of the semipolar double bond is critically examined and difficulties in accepting it are pointed out. Thus activation of two electrons is questioned. Fajans's Rules have been used to indicate the impossibility of such an activation. Kuhn's observation of lack of cis-trans isomers about each of the double in polyenes suggests that single bonds are absent from long conjugated chains. The trans addition to olefinic systems is a very strong argument against accepting the idea of the semiplar double bond. All these facts point to the conclusion that activation of double bonds should be represented as :—



$$>c=c< \longleftrightarrow >\overset{+\frac{1}{2}}{c}\ \underline{\cdots\cdots}\ \overset{-\frac{1}{2}}{c}< \longleftrightarrow >\overset{-\frac{1}{2}}{c}\ \underline{\underline{\cdots\cdots}}\ \overset{+\frac{1}{2}}{c}< \quad \text{and not as} \quad >c=c< \rightarrow >\overset{+}{c}\cdot\cdot\overset{-}{c}<$$

In this connection the theories put forward by Robert and Kimball, Robertson, and Anantkrishnan and Venkataramen are considered and a mechanism postulated on the basis of the theory of the resonating semipolar single bond. This mechanism is supposed to explain trans addition along with some cis addition, influence of catalysts and the negative temperature coefficient.

In support of the proposed mechanism other reactions of the olefines are pointed out in which most of the reactions take place with just those molecules which contain resonating semipolar single bonds. Some of the other addenda contain easily polarisable hydrogen which can assume the semipolar single bond structure. The case of hydrogen which is an apparent exception is shown strongly to support the mechanism of addition by semipolarisation of one bond out of two in the double bond.

·288. Resonating Semipolar Single Bond Part VI Molecular Rearrangements.

S. SHAMIM-AHMAD and HAMEEDUL HASAN, Aligarh.

A number of objections can be raised against the present ideas on Molecular Rearrangements. Whitmore's scheme can be criticised as it postulates the production of an open sextet as the driving force of the reactions. It also does not give the actual mechanism of the transfer, it being rather difficult to believe that bulky and sometimes optically active groups can change their positions with an instaneous jump. Double bond shifts and other anomalies cannot be explained if the formation of the sextet is not postulated. Moreover there is the fundamental objection that these mechanisms do not explain why rearrangements are not reversible. It is believed that the postulate of the resonating semipolar single bond can give a better explanation of the three fundamental questions : (i) Why do they take place ? (ii) Why are they not reversible ? (iii) How does the rearrangement take place in view of the stersochemical requirements ? Attention is directed to the fact that all the molecules undergoing rearrangements contain influences which can semipolarise single bonds as the atoms joined are electron attracting and of about equal electronegativity. These rearrangements are not reversible as bonds formed are not capable of semipolarisation. The retention of configuration is explained as the new bond is formed before the previous one is completely broken. Robinson's scheme of benzidine transformations is put forward to be based upon similar views though Dewar's idea of bond is less general.

289. Resonating Semipolar Single Bond Part VIII. Hyperconjugation, Strength of Acids and Calculation of Dipole Moments.

S. SHAMIM AHMAD, and M. A. WAJID,

The idea of Resonating semipolar Single Bond put forward earlier are applied to explain hyperconjugation and strength of acids. Dipole moments of halogenated methanes are calculated and found to agree with the observed values.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF GEOLOGY AND GEOGRAPHY

President :—Dr. L. A. N. IYER, M.A., Ph.D., D.I.C.

A. GEOLOGY

(i) MINERALOGY

1. The Development and growth of Cordierite in Para-lavas.

V. VENKATESH, Calcutta.

Some specimens of para-lavas from Bokaro coalfield formed by fusion and recrystallisation of sedimentary rocks due to the burning of underlying coal seams, show numerous crystals of cordierite. The size, shape, development and growth of these crystals have been described and four general types have been distinguished: (a) small symmetrical hexagonal grains, (b) clusters of spiral-shaped grains, (c) linked parallel clusters of hexagonal grains or rings, and (d) large, imperfect grains with tentacles or multiple terminations.

The crystal clusters of types (b) and (c) represent the initial stages of crystal formation, probably in the labile stage, and the large imperfect crystals have grown from these at a later stage. The conditions and rate of growth, responsible for the formation of these four general types, and influencing the size, shape, idiomorphism, perfection, symmetry and pattern of twinning of these crystals are discussed.

The preferred and easy growth towards the solid angles and edges and along the prism faces of the pseudo-hexagonal prism and the sluggish growth towards the prism face in rapidly grown cordierite crystals, are explained as being due to the degree of saturation of the atoms or molecules at these spots which afford the greatest or least total co-ordination and also probably due to the development of lineages in earlier stages. The differential growth giving rise to dendrites, skeletal crystals and imperfect crystals with multiple terminations is common in many rapidly grown minerals. The peculiarities of the atomic structure may influence this preferred growth by controlling the location, number and angular relations of these sites of easy and quick growth.

It is shown that slow, symmetrical mode of growth favours the formation of small star-shaped twins and symmetrical concentric twin patterns while rapid growth in preferred directions yields an irregular concentric twin pattern.

2. Occurrence of Chondrodite in the Calc-silicate rocks of Latehar, Palamau District.

M. S. SADASHIVAIAH and S. D. GHOSH, Dhanbad.

Chondrodite occurs in the calc-silicate rocks of Latehar as granules and patches associated with calcite, forsterite, spinel, forsterite-antigorite (serpentine), diopside, tremolite, phlogopite, and chlorite (clinochlore). Chondrodite is intimately associated with forsterite and spinel. The study of the thin sections shows that the chondrodite is developing from the olivine. In its properties the Latehar chondrodite is similar to the B-chondrodite of the Mansjö mountain, Sweden, and in its occurrence it is similar to the Glenelg chondrodite of Invernessshire. The origin of chondrodite from forsterite is ascribed to the accession of fluorine and hydroxyl-bearing fluids derived from the magma which gave rise to adjoining granite gneiss of the area.

3. A Note on the Idiomorphic Felspar Crystals from the Pegmatite of Charkhi Mine, Kodarma Mica-field.

Y. K. AGRAWAL and M. S. SADASHIVIAH, Dhanbad.

Two idiomorphic microcline crystals from the pegmatite of Charkhi Mine, near Jhumri Tilaiya, Kodarma, have been described crystallographically and mineralogically. In thin sections microcline shows perthitic texture by containing films and strings of albite and veins of oligoclase. The microcline perthite is of both exsolution and replacement type. The former contains films and strings of albite, and the latter veins of oligoclase. It is believed that the latter preceded the former; and after the crystallisation of the microcline crystals in the deeper levels from the pegmatitic portion of the magma, there had been an upsurgence of the crystal mesh, when the microcline exsolved the excess soda-rich material as films and streaks giving rise to the exsolution perthite. This was followed by the later deuteric hydrothermal replacement of the microcline perthite along the cleavage and contraction cracks already present, giving rise to the vein perthite

4. A preliminary study of crystal-size variation in a dolerite dyke, Jamunia River, Jharia Coalfield.

C. RAY, Calcutta.

The author measured systematically the length and width of felspar grains occurring in two sets of three specimens each from two different horizontal sections 150 yds. apart, along the width of an almost uniformly thick (50 ft.) dolerite dyke near the river Jamunia. The grain-size of each specimen has been expressed in terms of the arithmetic mean of the diameters of the circles equivalent in area to the respective felspar grains. The two cross-sections show difference in their relations of crystal-size variation with variation in location of samples from their respective centres. The western one displays a pronounced maximum at an intermediate distance between the centre and the margin and the one to the east, however, shows a progressive increase of grain-size from the margin to the centre. Thus, there is a difference of crystal-size variation not only across the dyke but also laterally. The mean L/B ratios of each sample has been worked out and plotted on the same graph. They are found to be inversely correlated with the mean diameters (in 0.1 mm). A quantitative relation between the average variations of the mean diameters (in .1 mm) and L/B ratios has been found out by means of Galton Graph and it is 0.23 i.e. for every change of 1% of the mean diameter there is a tendency for L/B to change in the opposite direction by 0.23%.

5. Ilmenite-monazite sands of Narsipatnam, Visakhapatnam District.

SAMIR KUMAR DAS, Calcutta.

A new deposit of ilmenite-monazite sands has been found by author near Narsipatnam (Lat, 17° 40'N: Long. 82° 36' 49'E), Visakhapatnam district. The above sands were mechanically analysed to determine the contents of the various minerals in the different size grades. The mineral fractions separated are magnetite, ilmenite-garnet, monazite, zircon, etc. The mechanical analyses show that sands belonging to 70-80 mesh (I. M. M. sieve) are rich in ilmenite-garnet and monazite fractions. The sands after mechanical analysis gave 26.45% and 3.23% of ilmenite garnet and monazite fractions respectively of 70-80 mesh size-grade.

Sands belonging to 70-80 mesh grade were chemically analysed and it is found that ilmenite-garnet fraction contains 43.31% of $Ti0_2$. The sands yielded 3.23% of monazite fraction of 70-80 mesh grade containing 7.69 % of $Th0_2$.

According to the author, the above deposit of sands is highly valuable with regard to ilmenite and monazite contents and should receive the immediate attention of the Atomic Energy Commission of the Government of India.

6. A study of the Mineralogy of the Charnockites of Waltair Area with Special Reference to the Optical Properties of Pyroxenes.

A. SRIRAMDAS, Waltair.

Charnockites are being quarried extensively in Waltair area for road metal. These operations have given rise to excellent rock exposures revealing the effect of assimilation of khondalites by charnockites which occur as intrusives into the former. The hybridisation has produced a series of rocks ranging from leptynites, hypersthene-granites to basic charnockites. These rocks show interesting progressive changes in mineralogical composition. This paper records the results of the study of such mineralogical changes with special reference to the changes in the optical properties of pyroxenes.

7. Optical properties of the micas from Visakhapatnam.

C. MAHADEVAN and N. SATHAPATHI, Waltair.

In the Visakhapatnam district and adjoining state of Orissa, recent work has brought to light several localities where micas of various types are found. These are roughly classified from physical appearance as ruby mica or muscovite and bronze mica or phlogopite. A systematic examination of five types of micas selected purely on their physical appearance reveals that their chemical compositions and optical properties do not always confirm to types but show recordable variation. The paper summarises, the results of optical studies of such micas. Further work on their chemical aspect is in progress.

8. Studies on some Radioactive Minerals from South India.

U. ASWATHANARAYANA, Waltair.

Detailed investigations were carried out on three typical radioactive minerals from South India—samarskite from Nellore, allanite from Madura and monazite from Travancore. The investigations comprise chemical analysis with special reference to rarer elements, autoradioagraphic studies, examination of physical and optical characters, discussion of the possible formulae, a comparative study of the data on similar occurrences elsewhere, calculation and interpretation of age.

It has been shown that the controversy raised by Holmes concerning the age of the Eastern Ghats can be solved, if the age is calculated correctly from Nandi and Sen's values.

Attempts have been made from a study of the data on metamict and non-metamict allanites, to formulate the nature of the changes that allanite undergoes when it becomes metamict. Evidence has been collected to show that the allanite from Madura had become metamict and hence is of dubious value as an age index.

It has been shown that the distribution pattern, chemical and mineralogical association of South Indian radioactive minerals are in conformity with the recent theories on the subject.

9. Manganese garnets from Chipurupalle Area, Vizagapatam District.

C. MAHADEVAN and J. S. R. KRISHNA RAO, Waltair,

Pyrolusite and Psilomelane contain disseminated granular manganese garnets. They show variation in colour and composition. They are red, blood-red, brown and yellow. They are not always typical spandites as suggested by Fermor but they are spandites, grandites grading into iron garnets, skiagites and andradites. They show alteration by meteoric water to form manganese ore. These garnets are surmised to have been formed by the hypograde metamorphism of impure manganese-bearing sediments of khondalite suite.

The paper presents analyses of five different types of garnets and discusses their association in relation to the geological environment.

10. On the Colour of Blue Quartz.

C. MAHADEVAN and S. N. VISVANATH, Waltair.

Research on the cause of colouration in quartz has engaged the attention of workers in this country and abroad. Mineral colouration has been broadly ascribed to (1) Chemical causes such as contamination, pigmentation, etc. or (2) Physical causes, such as state of subdivision, development of twin lamellae, etc. While more or less definite conclusions have been reached regarding smoky quartz, amethyst and rose quartz the origin of the colour in blue quartz has not been satisfactory explained, Postelmann, Watson and Beard ascribed the blueness of quartz to microscopic acicular inclusions of rutile. Holland identified inclusions in charnockite quartz as slender rutile needles and held them responsible for the colouration. Jayaraman correlated intensity of blueness in the charnockite quartz and in the Champion quartz to titania content, the titanium compound existing as colloidal particles. With a view to throwing fresh light on this problem, chemical and optical investigations were initiated into the cause of colouration in the blue quartz of the Kolar Gold Field area. The results of these investigations are embodied in this paper. It is concluded that the colouring is due to an optical effect created by microbrecciation and consequent internal reflections and is unrelated to any chemical pigment.

11. Genesis of Steatite in Mutchukota Area.

C. MAHADEVAN and C. BORRESWARA RAO, Waltair.

Amongst the economic minerals met with in the Cuddapah system, steatite is one of the most important. The steatite deposits near Mutchukota which are being exploited by Mr. B. Sanjeeva Reddy and a few other similar deposits in this area, pose some interesting problems regarding their genesis. The country rock in which they occur are the Vaimpalli limestones which may be described as magnesian limestones. The steatite is definitely associated with dolerite dykes and presumably the dykes have a role in the genesis of the mineral. Field and laboratory studies indicate that steatite in this area originated as a result of hydrothermal metamorphism of the Vaimpalli limestones the necessary constituents being supplied by the residual fluids of the near by dolerite. The association of such minerals as serpentine, calcite, wollastonite, and secondary quartz is in conformity with the suggested mode of genesis of steatite in this area.

12. Black Sand concentrates along the beach in South Visakhapatnam District.

C. MAHADEVAN, B. J. N. S. R. ANJANEYULU and Y. BALA SANKARAM, Waltair,

The coastal strip between Polavaram and Visakhapatnam (in Topo.. Sheets 65 0/2, 0/3, and 0/6, and 65 K/15) has been geologically surveyed with special reference to the black sand concentrates of the beach. Khondalite is the chief rock formation while the acid and intermediate charnokites occur as narrow sills.

About 90 samples of the sands both from the beach and the stream beds were collected, out of which twenty representative samples have been studied in detail in the laboratory. The power and drift of the waves, and the shape and gradient of the beach are the controlling factors in the formation of black sand concentrates. Magnetite, garnet and ilmenite are the chief heavy minerals present in the black sands, while zircon and monazite constitute very low percentages. Comparatively high percentages of ilmenite and monazite seem to be associated with black sands of high magnetite content while the reverse is the case with garnet-rich sands.

13. Geolgy of N. W. parts of Nellore District with special reference to origin of copper and barite.

C. MAHADEVAN and R. RANGAYYA, Waltair.

The occurrence of copper ore in Garimanipeta in Nellore district attracted some attention, but the reported occurrence of barite near Nerravad received scant notice from geological investigators. The present work consists of detailed mapping in the neighbouring areas in sheets 57 N/9, 57 N/5 and subsequent laboratory investigations. The rock formations in the area are Dharwar schists intrusive into which are trap dykes and sills, granites, pegmatites and quartz veins.

Chalcopyrite is the primary copper mineral occurring in a gangue of orthoclase, plagioclase and quartz. Chalcocite is of both platy and bluish varieties. The secondary minerals include malachite, azurite and some chalcocite. From field and laboratory evidences it is concluded that the copper mineralization is of hydrothermal type and that it is related to the same magma which gave rise to the pegmatite veins of the area. Evidences indicating the presence of secondary enrichment are also noted.

That barite is also formed from hydrothermal solutions is evidenced by the accompanying silicification and replacement of wall rock with barite and its association with oxidized copper ores.

(ii) PETROLOGY

14. On Some Sapphirine-bearing Rocks from the Khasi Hills, Assam.

A. M. N. GHOSH and A. K. SAHA, Calcutta.

The paper describes certain granulites and schists containing sapphirine, cordierite, green spinel and magnesia-rich biotite and occasional anthophyllite from three different localities on the Patharknang plateau in the western Khasi Hills. The rocks occur in association with hypersthene-granulites, as bands in biotite-cordierite-sillimanite gneiss which have been extensively granitised at places. From detailed optical studies it appears that the sapphirine is relatively rich in iron content. Some of the cordierite porphyroblasts are optically positive. The rocks appear to represent sediments rich in alumina and magnesia which were involved in metamorphism under deep seated conditions.

This is the third recorded occurrence of sapphirine in India.

15. Petrology of the Ilmenite-bearing Pyroxenites of Khalikote Estate.

N. SATHAPATHY, Waltair.

Rich deposits of ilmenite which occur as veins along with pink felspars have been found in parts of Khalikote estate. The ilmenite appears to be associated with other minerals of more or less similar physical characters but of uncertain indentity. The mode of origin of these ilmenite veins has aroused considerable interest in the minds of earlier geologists on account of their unusual association with felspar pegmatites. However, a detailed field study reveals that the ore is from a titaniferous pyroxenite which is intruded into the khondalites as well as into their pegmatitic intrusives. The permeation of the titaniferous pyroxenite magma into the khondalites and their acid intrusives, has given rise to different types of ilmenite pyroxene felspar gneisses with varying proportions of these three minerals. The present paper records the study of these rocks with special reference to the origin of the ilmenite ore.

16. Distribution of Radioactivity at Different levels from K. G. F. Mines.

C. MAHADEVAN and U. ASWATHANARAYANA, Waltair.

Representative specimens of rock types obtained from various depths and at regular intervals, by one of us (C. Mahadevan) were examined for their β -activity by Prof R. S. Krishnan and by us. When the data were studied in conjunction with relevant petrological and structural aspects, they yielded some interesting results regarding the distribution of radioactivity in Kolar rocks. It has been observed that (1) β -activity of schists and dykes increases with depth (2) β -activity curve of quartz veins is irregular, the histogram showing maxima when the quartz veins are feebly radioactive (3) the mica-pegmatites show high radioactive content (4) the β -activity of pegmatites is variable but has no relation with depth. These observations are in conformity with the petrological data which show that the acid constituents of the schists increase with depth, their effectiveness decreasing as the surface is approached. As the granitisation is generally attended by the introduction of traces of radioactive constituents in the pre-existing rock, such observations have been shown to be consistent with the theoretical aspects of the problem. It is pointed out that the hornblende schists constitute a typical case, where the real age of the pre-existing rock cannot be obtained by Wickman's "rock-lead" method, because of their contamination by later intrusives.

17. Manganiferous rocks and their associates in East Chipurupalle Area, Visakhapatnam District.

C. MAHADEVAN and N. V. A. S. PERUMAL, Waltair,

studied with special reference to the nature and genesis of rock types and manganese ore deposits found in the area.

The area comprising the eastern half of sheet No. 65 N/11 was geologically
The important rocks met with, are khondalites, charnockites, phorphyritic granites, banded gneisses and some hybrids. Basic charnockites show distinct intrusive relationship with the paragneisses, namely the khondalite suite. The phorphyritic granites are seen intrusive into the khondaties as well as into the basic charnockites; as a result of this minerals of the intruded rocks are seen incorporated in the intruding granites. The banded gneisses in the area seem to have been formed by felspathisation of the older paragneisses.

The manganese ore occurs in association with the khondalite suite and the granitic intrusions do not seem to have any effect on the deposition of the ore bodies.

18. Some observations on the interaction of Eastern Ghat rockhsuites in Visakhapatnam District.

C. MAHADEVAN and B. KUKKUTESWARA RAO, Waltair.

Fresh sections of the Eastern Ghats have been stripped open during the widening operations of the ghat road on the Ananthagiri range, fringing the eastern margin of the Eastern Ghats, in the Srungavarapukotta area of Visakhapatnam district. The sections reveal a great zone of interaction and transformation between the charnockites and the various members of the khondalite series Heterogeneity of texture, distinct gneissosity, predominence of garnets and marked felspathisation, are the characteristic features of the charnockites in the region which appear as sill-like intrusives into the khondalites. Though regionally the leptynite appear as reconstituted khondalites, some of them look like products of assimilation. Locally, though not on a large scale, the garnet appears to have been derived, at least in part, from a break down of the hypersthene. The fact that the basic charnockites occur as xenolyths in the leptynites and acid charnockites, suggests that they are the oldest members among the charnockites.

19. The Geology of the Manganese-bearing Rocks of Rayagada, Koraput District, Orissa.

C. MAHADEVAN and P. SATYANRAYAN RAO, Waltair.

During the survey of Rayagada area (Topo sheet No. 65 M/4), some manganese ore bodies were met with in the Khondalitic series, associated with the quarzites, near the village of Kutingi (19°05′: 83°10′). No instrusives are seen in the vicinity of the ore bodies. From analytical data it is seen that the manganese has a high iron value and low phosphorus contamination. In this respect it resembles the manganese deposits of Central Provinces. The manganese content ranges from 45 to 50 percent. The ores are sedimentary in origin and have been subsequently metamorphosed along with the paragneisses.

The other formations occurring in this area are quartzites, calc-granulites and garnetiferous gneisses of khondalitic system, the charnockites and granitic gneisses. There is very clear evidence of granitization in this area. The process can be traced through a series of rock types such as granitic gneisses, migmatites, etc.

20. A preliminary note on clouded feldspars and metamorphism in Mysore.

C. S. PICHAMUTHU, Bangalore.

The author is engaged in a study of the dyke rocks of Mysore State, with special reference to the phenomenon of clouding exhibited by the feldspars of these rocks. Over 400 dykes have been examined, and this paper gives a preliminary account of the results.

Some of the acid and intermediate porphyries, ultrabasic rocks, and granulitic types also occur as dykes, but the majority of them are basic dykes. The basic dykes of Mysore can be grouped into four divisions: (i) dolerites, (ii) quartz-dolerites, (iii) olivine-dolerites, and (iv) epidiorites and metadolerites.

In each of these groups of basic rocks, there are both types. Some have clear colourless feldspars, while others contain feldspars which have become clouded to varying degrees of intensity.

Apart from one or two small areas in the Closepet granites, there are two distinct regions in Mysore where practically all the dykes contain clouded feldspars. One is a large roughly oval area in the Hassan district, between Arsikere and Sravanabelagula. The other region lies in the south of the State and approximately corresponds to the charnockitic province of Fermor.

The significance of this phenomenon, and the light it throws on the metamorphism of Mysore rocks are discussed in the paper.

Hand specimens and specimens of dykes containing clouded feldspar, and a geological map of Mysore, showing the distribution of both clouded and unclouded dykes will be exhibited.

21. The Charnockites of the Mor valley, Santhal Parganas, Bihar.

S. C. CHATTERJEE, Patna.

In this paper the author has described the petrographical characters and field relations of a series of rocks ranging from acid charnockites through tonalitic varieties to norites and hornblende gneisses. The evidences as seen in the microscopic characters and field relations indicate a metamorphic origin under granulite facies conditions.

22. The Geology and Petrology of the Granites and the Associated Basic Rock, near Jabalpur, Madhya Pradesh.

V. N. CHHIBBER, Banaras.

The author has studied in detail the granites and the associated basic rock, occurring in the neighbourhood of Jabalpur (23°10'10" : 79°57'10") and has mapped the area geologically.

The earliest Archaean rock in the area is represented by a basic member of the charnockite group; its field, megascopic and microscopic characters have been noted. This is invaded by the granite, and interesting inclusions of the basic rock occur in the granite. These by interaction with the granitic magma have been converted into a dioritic rock. These xenoliths are described.

There are three main exposures of the granite in this area :—

(i) Granitic range, near Ghamapur village.

(ii) Near the Mahakoshal Mahavidyala, surrounding the Gokalpur Lake on three sides.

(iii) In the neighbourhood of Madan Mahal.

Perhaps all the exposures are connected underground and form a small batholith. Owing to the development of the various types of jointing the granite rock weathers into various shapes of blocks. Weathering by exfoliation is very characteristic and sometimes weathering along diagonal joints is responsible for the development of perched blocks. The soils, formed as a result of the weathering of the granites in the area, have also been studied. The normal rock is a coarse-grained biotite-granite but its texture is variable. It may be coarse-grained, finer grained, or gneissose. The modifications of the normal rock include hornblende-granite, microcline-granite, binary-mica granite, tourmaline-granite and the schorl rock.

23. A Study of the Geology and Petrology of the Deccan Trap, near Jabalpur, M. P.

V. N. CHHIBBER, Banaras.

The author mapped the area geologically and studied the Deccan Trap occurrences near Jabalpur ((23°10'10" : 79°57'10"). Overlying the Lametas are to be observed very interesting sections of the Deccan Trap. These are to be observed in the Chui Hill, Bara Simla Hill and Karondi Hill, with the characteristic dome-shaped hill to its west-south-west. The Deccan Trap is also exposed south of the town of Jabalpur in the form of low-lying flat-topped hills. These exposures represent an extension of the Plateau basalts of the Deccan. The rock exhibits typical spheroidal weathering. On the top the virgin soil is reddish-brown in colour but it turns black on cultivation.

The field characters have been noted, and the megascopic and microscopic characters of these basalts, collected from different localities have been described. The rock collected from the Deccan Trap near the Block House of the Bara Simla Hill is a normal augite-basalt. The specimen from near the top of Chhitapar plateau is a glassy modification of the normal rock. Other specimens are of vesicular and scoriaceous variety. Other varieties are also met with which possess texture intermediate between a basalt and a dolerite.

24. On the occurrence of Limestone at the border of Ranchi and Hazaribagh Districts, Bihar.

K. L. DAS, Calcutta.

The deposit was examined between Longs. 85°40′ to 85°52′ E. and Lats, 23°27′ to 23°30 N. The Chandil-Barkakana section of the B. N. Ry., is passing through the heart of the area.

The rocks of the area are metamorphic and are composed of fine-grained gneiss, mica-schist, quartzite, para-amphibolite, calc-silicate rock and limestone. The angle of dip in these rocks ranges from 60° to 90°, the strike being E-W approximately. They are intruded by some basic rocks which are now represented by amphibolites and hornblende schists. The whole formation was intruded by the porphyritic granite, pegmatite and quartz vein. Last of all there were some intrusions of dolerite.

Limestone occurs as beds interbanded with para-amphibolites and calc-silicate rocks. The individual thickness of a limestone band varies up to ten feet, but the aggregate thickness of the bands in a particular zone is sometimes more than 150 ft. Though the outcrops are in discontinuous patches, they occur in definite zones. During the field survey more than thirty exposures were observed.

Generally the limestone is white in colour, but greyish varieties are also found. The limestone varies from fine to coarse texture and is granoblastic. Sometimes fine disseminations of garnet crystals, different types of calc-silicate minerals, biotite and quartz are noticed in the main mass of limestone.

From field observations it appears that the intrusion of the porphyritic granite-gneiss is responsible for the development of the crystalline nature of limestone, the ptygmatic folding in calc-silicatae rock and para-amphibolite, and the formation of different types of calc-silicate minerals in the limestone.

The chemical character of the limestone has also been studied.

25. Para-lavas from Chirimiri Area, Sarguja District, M. P.

B. BISWAS, Calcutta.

Para-lavas from the Chirimiri area were described by Fermor as true lavas; later he revised his opinion and pointed out that the rocks are due to outcrop fire of coal. These include Barakar sediments in various stages of induration, fusion, vitrification and recrystallization. Some of these crystallized rocks are as coarse as a micro-gabbro. These rocks have been produced as a result of complete fusion of ferruginous sediments and subsequent crystallization ; minerals featuring these rocks are plagioclases of composition An_{50}—An_{80}, hypersthene, magnetite, an unusual clino-pyroxene and occasionally cordierite. The clino-pyroxene is strongly pleochroic from greenish-yellow to yellowish-brown, with two sets of orthogonal cleavage; it is biaxial negative, $Z' \wedge c$ being 46°-50°.

The minerals occurring in the fine-grained rocks (produced as a result of fusion of argillaceous and siliceous sediments) are plagioclase, (?) mullite, (?) sillimanite, tridymite, magnetite and a yellow mineral, probably a pyroxene, the determination of the minerals being difficult due to the fineness of the rocks.

26. A Biotite—lamprophyre (? Mica-peridotite) from the copper belt of Dhalbhum.

S. Ray and A. B. BISWAS, Calcutta.

A biotite—lamprophyre (? kersantite) is reported from the copper mines of Mosabani, Dhalbhum. It occurs as lenticular masses, evidently intrusive, concordant with the foliation of the schists and sheared granite, which form the country rock of the copper lodes.

The kersantite consists of a typically porphyritic rock with phenocrysts of euhedral phlogopitic biotite in a fine-grained obscure groundmass, now full of calcite, made up of needles of apatite and a spherulitic acid plagioclase of average refractive index of 1.53 and low birefringence. Biotite is often chloritised; calcite is often pseudomorphous after biotite.

The rock resembles very much the so-called mica-peridotites (lamprophyres) of the Gondwana coalfields, to the north.

This new occurrence of a kersantite so close in characters to the lamprophyre intrusives of the coalfields raises interesting questions regarding their geographical extent and their relationship with the igneous activities in the 'Shear Belt' of Singhbhum. As no critical study of the occurrence has been done in the field it is not useful to go into their discussion here..

27. Anorthosite in Chilka Area.

C. RAY, Calcutta.

A ridge-like promontory of anorthosite 3.5 × 1 sq. miles in area on the south-eastern shores of the southern end of the Chilka Lake, 4 miles S. E. of Rambha (19°32′N: 85°6′E) has been located by the author. The rock is hard, compact, melanocratic bronze-coloured and granitoid. Its sp. gravity is 2.71. Under the microscope the rock is found to be medium grained granular hypidiomorphic, made up essentially of plagioclase-labradorite (Ab_{35} An_{65}) with Ng-1.569 : Np-1.560 and biref-0.009 with 3 or 4 small grains of rhombic pyroxene showing straight extinction. Patches of secondary calcite probably derived from plagioclase occur as fissure-fillings along with chlorite and with a little magnetite. A volume analysis gives the following percentage of the constituent minerals:—labradorite-96.68%, calcite-2.35%, chlorite-0.97% and magnetite-0.03%.

28. Studies on the basic dykes at Kakarapar, Gujarat.

AJIT KUMAR SAHA, Calcutta.

The phenomenon of magmatic differentiation shown by two basic dykes, intrusive into the Deccan Trap basalts on the bed and banks of the Tapti River near Kakarapar (46 G/7 ; 21° 16′ : 73° 22′), has been studied in detail. One of these, a coarse-grained, 50-260 ft. wide olivine-dolerite dyke, shows a less basic, non-olivinic, feldspar-rich marginal part, cut across by some thin aplite veins. The marginal parts of the dyke are considered to have intruded later than the main dyke, but before the solidification of the main dyke was complete; the aplites too are shown to be products of differentiation of the partial magma which gave rise to the dyke. The other dyke studied is a 17-30 ft. wide, fine-grained dolerite with 4-5 ft. wide patches of diorite along its central part and a chilled margin, which is more basic in composition than the normal dyke material. Petrographic data, including volumetric mineral proportions, of a number of samples from these dykes clearly demonstrate the nature of differentiation.

Variations in grain size and length to breadth ratios of plagioclase grains along certain cross-sections of the above two dykes have been statistically studied. In both the dykes, the mean diameters of plagioclase show a gradual increase from the margins to the centre. The length-breath ratios of plagioclase have been found to bear a clear inverse relation to the mean diameters. Statistical analysis of the data shows that for every change of 1% in mean diameter (in unit of 0.1 mm) the tendecies for the length-breadth ratio to change in the opposite direction are 0.62% for the olivine dolerite dyke and 1.4% for the fine-grained dolerite dyke. In the former case, a simple correlation constant has also been determined.

29. Petrography of the Rajmahal Lava Rocks from Begum Pahar, Santhal Pargns. Bihar.

RADHANATH DATTA, Calcutta.

A petrographical description of a series of trap rocks belonging to the Rajmahal volcanic△ of Jurassic age is given here. These trap rocks have been collected from the hill Begum Pahar, in the Godda sub-division of the district Santhal Parganas in Bihar. The hill constitutes the northern portion of the Rajmahal Hills. In all eight trap flows and seven intertrappean sedimentary beds have been detected ; the remnants of the eighth intertrappean bed on the top of the eighth flow are still left in △ 837 feet peak in the form of shale and laterite pebbles. The trap series rest on the Dubrajpur grit and Barakar sandstone of Gondwana age. The trap rocks are all of basaltic composition and contain plagioclase, pyroxene, iron ore, glass and secondary minerals like chlorophaeite and palagonite. They are free from olivine. Some of the sedimentary intertrappean beds are tuffite. Two fossil plants were obtained from a tuffite intertrappean bed from the middle portion of the trap series; they are *Ptilophyllum acutifolium* and *Nilssonia princeps*. These rocks are similar to the traps from other parts of the Rajmahal Hills, and to the Deccan Trap in general.

30. Cordierite—Hypersthene Granulites near Kunigal Bordering the Western margin of Closepet Granite.

B. P. RADHAKRISHANA, Bangalore.

A new occurrence of thin bands of cordierite-hypersthene-granulites fringing the western margin of the Closepet granite is described. The following minerals constitute the rock arranged in the order of their abundance: cordierite, biotite, hypersthene, garnet, quartz, magnetite spinel, sillimanite and apatite. Cordierite occurs both in grains and as coarse plates and is violet in colour. Lamellar twinning with interdigitation of lamellae is common. The cordierte is optically positive. Garnet and hypersthene appear to be mutually exclusive and restricted to separate bands in the rock.

The finely laminated character of the rock, the segregation of garnet, hypersthene and cordierite in definite bands indicates an original laminated sediment. The development of cordierite, deep brown biotite, hypersthene and garnet is indicated to be the result of contact thermal metamorphism of an original argillaceous sediment by the intruding Closepet granite.

(iii) STRATIGRAPHY AND PALAEONTOLOGY

31. Non-diastrophic Sedimentary Structures from the Lower Gondwanas of Chirimiri Area, Sarguja Dist., C. P.

B. BISWAS, Calcutta.

Primary sedimentary structures in Barakar rocks described in this paper throw some light on the problem of Lower Gondwana sedimentation in the area concerned. These are:—

(i) Clay pellets—Flattened pellets of clay of greenish colour less than ½″ in diameter occur as discoidal bodies in fine-grained lower Barakar sandstones. These appear to have been derived from unlithified Talchir clay through fluvial agency. (ii) Mud-cracks—Mud-cracked polygons upturned at the edges i.e. convex in shape when viewed from top, occur in lower Barakar silty sandstones. The shape of the polygons indicates their origin in fresh water. (iii) Incompetent folds—Folding on a minute scale prior to complete lithification in Barakar rocks indicates differential compaction owing possibly to sub-aerial exposure of the basin of sedimentation. (iv) Incline-bedding (cross-bedding). The inclination of the foreset laminae has a persistent dip towards N-NNW throughout the area. This suggests the flow of water into the basin from S-SSE direction i.e. across the so-called Satpura protaxis which forms the watershed at present.

32. Some Recent Foraminifera and other Organic Remains from the Shore sand of Bombay.

A. CHAUDHURI and B. BISWAS, Calcutta.

Studies of recent microscopic marine organisms are comparatively new in India, and more particularly of the smaller Foraminifera, Bryozoa, Ostracoda, alcyonarian coral, sclerodermites, ontogenetic forms of larger animal remains, etc. The present paper deals with a collection of such remains from Juhu, Bombay.

33. On the Alluvial Deposits of the Narbada valley, near Bheraghat, Jabalpur District, M. P.

V. N. CHHIBBER, Banaras.

The alluvial deposits of the above region can be divided into Older Alluvium and Newer Alluvium. The former comprises the flood plain of the Narbada and is to be observed above the present flood level of the river. The Newer Alluvium represents the deposits which are being made by the river in its bed and sides, wherever the conditions are favourable for its deposition.

The best sections of the Older Alluvium are to be observed in the cliff sections adjoining the Narbada, which sometimes attain a thickness of 90 feet or even more. These sections are again exposed in the deep ravines adjoining the river. The Older Alluvium is composed chiefly of a stiff, reddish, brownish or yellowish clay, containing an abundance of concretions of kankar. It is usually separated from the underlying rock by a small thickness of sandy and conglomeratic beds; where this lower alluvium has not suffered too extensive denudation prior to the deposition of the upper alluvium, the clays are usually overlain by a small thickness of sandy and gravelly beds which carry bone remains. A chemical analysis of a sample of the Older Alluvium from near Tilwaraghat reveals that the soil has low content of organic matter and nitrogen.

A full description of the Newer Alluvium is also given.

34. Some new Fossils from the Baripada Beds, Mayurbhanj, Orissa.

G. K. MODAK, Calcutta.

Several species of *Ostrea* and *Amphistegina* or *Rotalia* were described by P. N. Bose (1903-04), Pilgrim, Tipper, Eames (1937), S. C. Chatterjee (1945), and B. H. Jena (1942-43), obtained from the Baripada beds, near the village Mahulia, about 2 miles south of Baripada (22°0′0″ : 86°) and Mukurmatia, about 8 miles south of it in the Mayurbhanj district, Orissa. B. H. Jena and S. C. Chatterjee noted further the occurrence of *Cardium, Leda, Nucula* and some vertebrate remains.

This paper records the occurrence of some other lamellibranchs and of elasmobranchs in the limestone and fine-grained yellow calcareous sandy shale, near Mukurmatia.

The lamellibranchs include *Trigonia, Cardita, Nucula* and one species of *Ostrea*, while the elasmobranchs include the shark teeth, *Hemipristis* and *Myliobatis*-a fragment of caudal spine of shark, and also a biconcave centrum, probablya fragment of fish vertebra. One species of *Ostrea* viz. *Ostrea promensis* Noeteing and one species of *Hemipristis* viz. *Hemipristis serra* Agassiz, identical with those of the Pegu beds (Lower Miocene) of Burma have been detected.

From the faunal assemblage it is evident that the Baripada bed is Lower Miocene in age suggested by previous workers. A marine transgression in this region in the Lower Miocene is thus indicated.

35. A Giant Pelecypod from the Cretaceous Rocks of Trichinopoly.

SRIPADRAO KILPADY, Nagpur.

The paper presents a preliminary report of the discovery of a giant pelecypod from the Cretaceous rocks in the neighbourhood of Sillakudi (lat : 11°4′ ; long : 79°2′) in the Ariyalur District.

The specimen is incomplete and consists only of one valve. The length of the shell is about 17 inches; the height is about 22 inches and the thickness over

10 inches. The shell is vertically elongate, shield-shaped and inflated. The umbo is orthogyral or only slightly prosogyral. The surface ornamentation consists of 10 large radial folds and troughs, about 3 inches apart from crest to crest at the widest part. There is discrepant ornamentation along the median line of the valve consisting of three straight acute ridges about an inch apart. The undulations on either side of this region are symmetrically disposed. The ventral margin of the valve is broadly plicate and the shell appears to have been of the closed type.

Pelecypods are amongst the commonest fossils in the geologic record and attain their acme of development at the present time represented by forms like *Tridacna* which attain very huge dimensions (Length : 2-3 feet and weight 2-3 cwts.) In the Cretaceous period the pelecypods never attained large dimensions (while some of the cephalopods did) and consequently the discovery of a giant pelecypod from the Trichinopoly region is of unusual interest and importance. Many of the most bizarre types of pelecypods are said to have evolved and become extinct during the Cretaceous. The find reported in this paper appears to be one such.

36. Geology of the Dodguni Anticline.

B. P. RADHAKRISHNA.

A portion of the Chitaldrug belt of schists near Dodguni, Tumkur District, which includes within its limits almost all the principal rock types forming the Dharwars of Mysore, has been selected for detailed study. The structure of this part of the schist belt is shown to be in the form of a pitching anticline. The stratigraphic succession and the relative order of superposition of the different beds has been worked out and a brief description of the characteristics of the more important rock types are presented.

The succession of rock types as exposed in this schist belt has been divided into two series: Older metamorphic series which is predominently igneous and a younger Dodguni series predominantly sedimentary. The following sequence is indicated as the correct order in which the different rock types were formed :—

Dodguni Series.
- Sills of epidiorite.
- Mica-schists.
- Banded ferruginous quartzites locally passing on to iron ores.
- High calcium limestones.
- Dolomitic limestone.
- Maganiferous limestone and phyllites.
- Phyllites and mica-schists.
- Local beds of conglomerate.

Metamorphic Series.
- Amygdular hornblendic schists with intercalated phyllites and mica-schists.
- Kondli quartzites.
- Hornblendic and amphibolitic traps.

Basement not recognised.

37. The Age of the Mandi Salt-Belt.

A. K. GHOSH and R. B. MAZUMDAR, Calcutta.

The controversy about the age of the Saline Series is well known. Prof. Sahni and his collaborators have reported their results of examination of samples from the Salt Range of Punjab and Kohat. They are of opinion that palaeobotanical findings support definitely the Post-Cambrian hypothesis for the Series (Proc. Nat, Acad, Sci., B. **14** ; Proc. Nat Acad, Sci., B, **16**) They have not reported on any samples from Mandi (31 44′ : 76 56′) in Mandi district, within the outer Himalayas. Hence the present investigation is undertaken in order to find out whether the Mandi salt sequence will yield any microfossil assemblage referable to those already recovered from other salt beds or not.

The following samples examined were received through the courtesy of the Director, Geological Survey of India, collected from the Himachal Pradesh, Mandi Dt., Mandi Salt Belt:—

Regd. No.	Locality	Materials.
58/1015 A	31° 47′ 48″ : 76° 57′ ; S. of Bhatog near 4565 Khalsa village	
58/1524 B	31° 57′ 45″ : 76° 51′ 15″	Limestone.
58/1041 B	31° 45′ 42″ : 76° 57′ 12″	Shaly Limestone.
58/1044 A	31° 45′ 40″ : 76° 57′ 24″	Red Limestone.
	Megal Stream section	Lokhan Limestone-Salt sequence.
58/1046	Draug Salt Mine.	Salt.

Innumerable pieces of carbonized and non-carbonized wood fragments with reticulate, simple or bordered pittings and fragments with well preserved medullary rays are recorded, in addition to a number of cuticles and spores. Fragments resembling hair of dermestid larva, parts of chitinous membrane with smooth, tapering hairs emerging from the sockets are not uncommon.

38. Correlation of some Coastal Gondwanas in Parts of Guntur and Nellore Districts.

C. MAHADEVAN and K. SURYANARAYANA, Waltair.

The occurrence of poorly fossiliferous beds near Kandukur in Nellor district is a common and interesting observation in wells and water courses. These formations namely sandstones and shales yield, according to the previous reports, unrecognisable indistinct plant remains. But during the course of field work by one of us a new fossiliferous area was met with which is situated towards east of Kandukur from which good recognisable plant fossils were obtained. These show affinities with Rajmahal flora. The present work is mainly based on the study of the heavy minerals of the sedimentary rocks of the Kandukur group. Wtih the help of the data thus obtained these beds are correlated to the Upper Gondwana formations of Ongole area. The similarities between the Kandukur group of sandstones and the Gondwanas of Ongole area (Budavada group) are fully discussed based on both field evidence as well as laboratory investigations and heavy mineral properties and their frequency values. The heavy mineral investigations carried out on these rocks not only help us in correlating this group with the proved Gondwanas of Ongole area (Lower Jurassic) but also throw some light on the application of these micropetrological methods in solving geological problems.

39. A Heavy Mineral Correlation of the Sedimentaries of East Godavary and Visakhapatnam Districts.

C. MAHADEVAN and A. SRIRAMADAS, Waltair.

A few detached sedimentary formations consisting of argillaceous and ferruginous sandstones gritty and conglomeratic at places, occur along the coast of East Godavary and Visakhapatnam districts in the neighbourhood of Tuni. According to a few ill-preserved fossil casts found in them they were assigned the age of Upper Jurassic by King (1880). In view of their doubtful geological age based on the evidence from fragmentary fossils, correlation by a detailed heavy mineral analysis was undertaken. The results of these studies have been graphically represented and interpreted. They show strong similarity with Tirupaty beds of Upper Jurassic age.

40. Geology of Yellamanchili Area.

C. MAHADEVAN and P. PERRAJU, Waltair.

The khondalites of the Yellamanchili area (western half of sheet No. 65K/14) consist of quartzites, garnet-sillimanite-gneisses, calc-granulites and manganiferous gneisses of the Khondalite series into which are intruded in some places sills of charnockite. The basic charnockites occur typically as sills and lenticles and the intermediate charnockites as outcrops of wider extent. At the contact of charnockites and khondalites, nuggets of garnets and nests of biotite in charnockites are developed. Leptynites and garnetiferous granulites occur in between the khondalites and charnockites. They appear to be due to the reconstitution of khondalites with some admixture with charnockitic material during the intrusion by charnockites. The paper describes the field relationship of these formations with particular reference to the contact phenomenon.

41. A Note on the occurrence of Gondwanidium and Buriadia from the Karharbari Stage in the North Karanpura Coalfield.

S. N. PURI, Calcutta.

The note describes the occurrence of *Gondwanidium validum* and *Buriadia sewardi* (typical Karharbari plant fossils) from the beds hitherto included in the Barakar stage by Jowett. They are of further significance, as besides being a new locality for these characteristic Karharbari fossils, they also help considerably in the demarcation of the Barakar-Karharbari boundary in that area.

The note also describe *Gondwanidium validum* and *Buriadia sewardi* in detail, in addition to some fronds of *Glossopteris* and *Gangamopteris* and one specimen referable to *Schizoneura.*

(iv) ECONOMIC GEOLOGY

42. The Economic Minerals of the Region near Jabalpur and Bheraghat, M.P.

V. N. CHHIBBER, Banaras.

The author has mapped the area near Jabalpur (23° 10′ 10″ : 79° 57′ 10″) and Bheraghat (23° 7′ 50″ : 79° 48′ 1″)' geologically (covering about 100 square miles) and has studied in detail the economic minerals in this area. The minerals of economic value comprise the following, and they are dealt with in detail in the paper.

1. Fire clay.
2. Glass-sands.
3. Steatite
4. Marble and dolomite.
5. Quartz, chalcedony, and jasper.
6. Building stones and road metal.

43. Aspects of the Zonal Theory of Ore-deposition in the Kolar Gold Fields.

C. MAHADEVAN and S. N. VISVANATH, Waltair.

The economic significance of the zonal theory of ore-deposition lies in the information it gives us regarding variations of mineral assemblage with depth. On account of its unique depth, this theory can best be verified in the underground workings of the Kolar Gold Fields. While *prima facie* there is support for this hypothesis, a more critical examination reveals that it is not so rigorous. As a result of investigations carried out on this problem, certain interesting conclusions have been reached. (1) The nature of wall rock alteration changes with depth and its intensity diminishes (2) Pegmatitic streaks and clots increase with depth (3) Tourmaline and Albite of the reef increase with depth (4) The hornblende in the hornblende-schist decreases with depth (5) Degree of brecciation is more closely related to proximity of faults than to depth (6) The dykes are less altered at depth and the prophyritic types are more common in depth and (7) The sulphides show a rude zonal arrangement with respect to depth.

The bearing of these observed changes with depth on the nature and distribution of gold values is discussed.

44.* Economic Minerals of Kothavalsa area Visakhapatnam District.

S. V. LAKSHMI NARAYANA RAO, Waltair.

In the Kothavalsa area, within the rock suites of the Eastern Ghat series, quartzites, garnetiferous gneisses, sillimanite gneisses and granitic gneisses are the important rock types met with. Quartzites predominate in the northern part of the area, whereas garnetiferous gneisses occur in southern region. Granitic gneisses occur as small patches in the quartzitic country.

Manganese occurs in association with garnetiferous gneisses at Kantakapalle area. Part of the ore represents the original sedimentary deposit while the rest is derived from the alteration of mangenese minerals like garnets and pyroxenes. Sillimanite occurs as concentrates at Relli village. Muscovite type of mica has been met with, at various places around Kothavalsa area, associated with quartz and pegmatite veins. Vein quartz is sufficiently pure to be used in glass industry. White and transparent crystals of quartz form an entire hillock near Appana-Dorapalem. Occasionally they have a with of 1″ and a length up to 3″. Kaolin has been noticed at Gummidikonda hill on the northern flanks which can be profitably mined.

(v) METEORITE

45. Valudavur Meteorite..

A. K. DEY, Madras.

The meteorite which fell with a droning sound, similar to that of an aircraft, between 5 and 5.10 P.M. on October 30, 1944, in a wet paddy field at Valudavur in South Arcot district, Madras has been studied in detail. It is a more or less rhomboidal mass resembling a half-broken boulder weighing about 2799 grams and measuring 17.3 cm lengthwise, 13.2 cm breadthwise and 7 cm in thickness. It has a superficial crust of steel grey colour, 0.1 to 0.7 mm in thickness and finely granular in texture. The chondritic structure is very apparent in microsection though not readily visible to the unaided eye. Al, Ca, Cr, Co, Cu, Fe, Ga, Ge, Mg, Na, Ni and Si have been detected spectrographically. It is an aerolite which may be classified as a grey chondrite (Cg).

B. GEOGRAPHY

(i) PHYSIOGRAPHY

46. A Study of the Malaprabha River Basin with special reference to the Palaeolithic Sites.

R. V. JOSHI, Dharwar.

A report of the survey of a part of the Malaprabha river (Bombay State) is given in this paper. It includes both the geological and archaeological (prehistoric) observations of this region. Nearly fifteen new palaeolithic sites were discovered and a good number of cliff sections were studied. Some points regarding the structure of the Malaprabha basin are also discussed in this paper.

47. Natural Divisions of the Damodar Valley.

S. C. BOSE, Calcutta.

The Damodar Valley has been divided into twelve regions as follows:—

(1) "Kana" rivers corridor
(2) Tract of the "Hanas".
(3) Beheaded rivers belt
(4) The Sali Valley
(5) The Collieries
(6) Parasnath-Tundi Range
(7) Jamtara Peneplain
(8) Koderma-Giridih Mica Zone
(9) Hazaribagh Plateau
(10) Karanpura
(11) Ranchi Plateau Fringe
(12) Trap Hills watershed.

The divisions have been made on the basis of the present cultural landscape as produced by the complex interaction between man, armed with his present cultural equipment, and the natural environment around him.

It is desirable that any future planning and development of the valley should be based upon these natural regions.

(ii) HUMAN

48. The Polavaram Project—A plea for its Revision.

K. BAGCHI, Calcutta.

Polavaram is the site of a dam that has been proposed to be constructed across the Godavari on a multipurpose basis. The dam is likely to be a costly undertaking and it is proper that the project should be thoroughly discussed and duly considered before it is actually carried out. The geographical background of the Godavari basin was already placed by the same author before the Poona session of the Indian Science Congress. In the present paper the author discusses the hydrological aspects of the Godavari catchment area and proceeds to show that the Polavaram dam, if the site proves suitable, should be constructed last of all when a number of smaller dams have already been constructed across the tributaries. The integrated development of the Godavari basin depends on the construction of not **one** dam but **a number of dams** at different points in the catchment. If the Polavaram dam is taken up first, its life and the storage capacity of the reservoir, the author maintains, will be seriously affected due to silting and other complications. The paper is illustrated cartographically.

49. Telegus of Andhra Coast.

K. N. MUKHERJEE, Calcutta.

Telegus may be found all along the coastal plains of Northern Circars, right from the deltaic plains of Mahanadi to the twin deltas of Kistna-Godavari. But at both the extremities, on the deltas, better opportunities of livelihood due to higher rainfall and irrigational facilities and also due to the influence of the more advanced groups of adjoining people, the Telegus have lost their natural characteristic and splendour. So the fairly dry coastal tract of Andhradesha, in between the deltas, provides unique scope for the study of environmental influence, which so clearly crystallizes in the elements of cultural landscape of the region.

The paper also deals with the racial affinities of the Telegus, their occupation, the climate of their country, etc.

50. Study in City Growth and Morphology.

P. P. KARAN, Patna.

The urban geography of Patna and Jamshedpur which has been studied in this paper, are distinct. Patna has a long history behind it. Its original site and subsequent growth have been materially affected by its strategic location at the confluence of navigable rivers and the crossroads of travel in ancient India. Jamshedpur, on the other hand, is a product of the twentieth century development —the iron and steel industries.

Patna can be divided into four functional zones: (i) the river front or the Ganges side given over to educational institutions, government offices and quarters; (ii) the business section around Chauk; (iii) the residential area from Pachhim Darwaza to Maidan ; and (iv) the new capital and Bankipore containing government offices.

The industrial city of Jamshedpur with modern layout, has been built according to a plan on a virgin site so that the settlement is neat, open and uniform with substantial buildings having flattish skyline, broad roads, number of green spots and a notable differentiation of functional zones, viz, the Civil Station, the business area, the industrial area, and the industrial-cum-residential area. The industrial zone containing the 'master plant' is quite apart from residential section. Jamshedpur is unique among the urban centres of India in respect of a marked segregation of the functions and subsequent absence of congestion. The factories are so widely spaced that it is not the chimneys but gardens that dominate the urban landscape.

51. Urban Structure in Western India : Poona, a sample study

R. V. JOSHI, Dharwar.

The increasing tendency towards urbanisation is remarkable in the human geography of India. Although in certain features the Indian cities are similar to those of Western, they still show some pecularities of their own. In this paper these structural pecularities are described in detail with reference to the Poona City. Poona, with a population of about six lacs, exhibits aspects more varied and interesting than any other settlement in Western India. The complex influences like—

1. The glorious historical past
2. The educational and cultural importance
3. The administrative influence
4. The military and partly industrial influences, are responsible for the rapid expansion of this city.

52. Agricultural Land—productivity of West Bengal

V, L. S, P, RAO and K, N. MUKHERJEE, Calcutta.

This paper records the results of the authors' correlation and synthetic studies in land-productivity and population pressure in the state of West Bengal. Five grades of 'land product' on the basis of the inherent character of the 'land type' and four grades of 'population pressure' on the basis of the man-land ratio have been recognised. Both the actual and the potential use of land have been taken into account in judging the carrying capacity of agricultural land.

From the analysis of the different 'land types' in relation to population pressure, it becomes evident that there is scope for increasing the productivity of the land and also for population re-adjustment between different regional units, in which case a well-conceived and integrated land-policy is imperative.

53. Shape analysis of Gondwana Sandstones of the Raniganj Basin.

S. SEN and S. RAYCHAUDHURI, Calcutta.

The paper reports the shape analysis of some Gondwana sandstones from the Raniganj basin. The mechanical analysis of the samples and some interpretations therefrom, had already been reported during the last session of the Science Congress. All the samples have been taken from the Raniganj series. Of these six occupy the uppermost horizon of the series lying close to the conglomerates that separate the series from the upper Panchet Series. The remainder belong to the middle horizons of the Raniganj Series.

Four units of the mechanical analysis, that is to say four size grade (.5-.35, 35-.25, .25-.177, 177-.125 mm), were utilized for shape analysis. After separating the heavy minerals from each of these units, the lighter crop, was digested in HCl and a small fraction was mounted in a medium of a liquid with high refractive index for shape study under the microscope. The sphericity indtx of individual grains, which is the ratio of the area of each grain to the area of the smallest circumscribed circle, was determined from the camera lucida drawings of the grains on a centimeter graph. The length and bredth of the individual grains were measured with the help of a micrometer occular and the ratio bredth to length was plotted against length (Hagerman). The sphericity index shows almost no correlation to size and the average value in all the grains lies close to 0.65, very few lying below 0.45 or above 0.8. The Hagerman scatter diagrams for the different samples (generalised for the four size grades) plot within irregular enclosures, which on superposition show a considerable amount of correspondence. An interseting feature of importance is that in all the samples the maximum concentration lies within the ratios 0..58 to 0.92.

54. The Structure of the Alkaline Rocks of Kishangarh, Rajasthan.

DIPANKAR NIYOGI, M.Sc., Kharagpur.

The paper embodies a preliminary report on the investigations about the structural pecularities of the Kishangarh occurrence of the rare rocktype. Perfectly conformable to the structure of the country-rocks, the sill-like bodies of the nepheline syenites show a transverse symmetry in the arrangement of the four textural varieties which from border inwards are: the impregnation type, a gneissic alteration of the country schists and the next type, the well-foliated type which latter is marked by very well-developed lineation and good foliation; the slightly foliated type showing good lineation and slight foliation; and lastly, at the centre, the very coarse grained type showing only a slight lineation. Lineation consists in rod-like aggregation of equidimensional nepheline and felspar grains, and foliation in flattened clots or schlierens of biotite and amphibole. Even in the types in which both the structures are present, the former is always the dominant one. Both tension and compression joints are present. Some sets have disrupted the foliation and contain alkaline pegmatites and veins. These facts indicate the primary nature of some of the joints and the lineation and foliation. However, inclusions occasionally appear to be discordant with the lineation and foliation of the enclosing nepheline syenites. This, together with the perfect concordance of the foliation in the nepheline syenite with the foliation of the adjacent country-rocks, indicates the secondary nature of the structures of the alkaline rocks. These conflicting observations may be explained by accepting the presence of both primary and secondary structures, which will have to be proved by detailed statistical field investigations and petrofabric studies. Exfoliation seems to be due to a pair of low-lying longitudinal joints.

55. Petrogeometric interpretation of A crushed conglomerate from Rangamatia, Singhbhum Dist., Bihar.

P. KAR and UDAY N. SARKAR, Calcutta.

A peculiar macro structured of an impersistent quartzite band of the Iron Ore Stage was observed immediately to the north of Rangamatia (22°45½ '86°02'), Singhbhum Dist., Bihar,—close to the main thrust zone. The band consisted of a number of small exposures separated from one another. Two of the exposures were seen to be made up of elliptoidal pebbles of quartz cemented together in a matrix of quartz, magnetite, sericite and biotite. The long axes of the pebbles seemed to lie in a particular direction. The pebbles were more or less flattened with their flat surface lying statistically parallel to the **ab** plane of the megascopic fabric. The spatial orientation of 100 pebbles selected at random were measured from the two exposures and their long axes were found to lie, with slight deviations, parallel to 60°. This lineation of the megascopic fabric was chosen as the **b** axis and three quartz axes diagrams were prepared from sections made with reference to this axis.

One non-selective diagram prepared from a statistical study of 100 quartz grains in a section parallel to the ac plane revealed well-developed ac girdle with minor constituting a pebble and 100 grains composing the matrix, prepared from study of similar sections from other specimens, were identical with the pattern of the non-selective diagram; so that, the fabric of the pebbles was homogeneous with that of the matrix.

The diagrams suggest that the pebbles together with the matrix were rolled simultaneously, parallel to the b axis, producing the ac girdle. This rolling had presumably caused a concommitant elongation parallel to **b,** owing to which the pebbles were drawn out in that direction. Such elongation may explain the minor concentration round **b.**

56. Structure and Petrology of a Dolerite Dyke Near Shihulibari (86° 44° 40″ E, 23° 39′ N), N. Manbhum, Bihar.

SAURINDRANATH SEN and SUNILKUMAR RAYCHAUDHURI, Calcutta University.

An olivine dolerite dyke cutting vertically across the archaean metamorphites (amphibolites) occurs beautifully exposed on the bed of the river Utla, west of Shihulibari (86° 44′ 40″ E, 23° 39′ N; 73 I/10). The trend of the dyke is 348° and it lies athwart the structural alignments of the country rocks having a strike of 70°. Thin apophyses, arising from the dyke, are seen to penetrate the wall rocks at various angles. Four sets of joints have been developed and they are found to be more frequent and better-formed towards the border adjacent to the chilledzones. These primary joints whose spatial positions bear no relation to the structural trends of the country rocks, prove that the movement of emplacement of the dyke continued upto and later than the complete solidification of the rocks, Interesting features regarding the petrology of the dyke are that (1) the chilled borders are devoid of olivine which is quite appreciable in proportion in other parts of the dyke, (2) the pyroxene is enstatitic augite ($En_{56}Wo_{34}Fs_{10}$) in the main portion while the augite is more calcic and ferriferous in the chilled borders, (3) the olivine varies slightly in composition and as mainly fayalitic (Fa_{60} ca), (4) the apophyses are seen to continue in the country rock as calcite veins; Cross cutting calcite veins also arise out of the body of the dyke, (5) the average size of the plagioclase shows apositive correlation with the modal percentage of the mineral, but the two vary irregularly along the width of the dyke.

All the evidences, structural and petrologic, point to the fact that the dyke intruded just beyond the intratelluric stage, subsequent to the complete crystallization of the olivine, and with the minimum liquid that was just sufficient to give it the required mobility. This liquid, obviously more enriched in Ca, squeezed outwards towards the border, got chilled in contact with the wall rocks solidifying as a glass with some phenocrysts of feldspar and augite. The pyroxene of the chilled phase has obviously crystallised later than the pyroxene of the middles.

57. On the fabric of the "granulites" of E. Manbhum and the granitization problem.

SAURINDRANATH SEN, Calcutta.

A comparative study of the quartz grain orientation of the argillaceous metamorphites and the associated granite gneiss in East Manbhum seem to offer unequivocal proof as to the metasomatic origin of the latter. The granite-gneiss, very similar to the Chotanagpur granite gnesis of Dunn, shows gradual and imperceptible passage in the field, from the metamorphites. The rock is mainly fine to medium grained leptynitic, resembling the "granulites" of German authors. Selective and non-selective diagrams from the granite gneiss, show the fabric to be homogeneous, and the fabric (peripheral **ac** girdle mainly) is identical to that of the associated metamorphites and ultrametamorphites. The flattened "granulitic" quartz thus retain mimetically, the original fabric. And the granitization, on such premises, could only be explained as to have been effected by metasomatosis; the introduced quartz mimics the original space-lattice orientation which remained undisturbed in the process.

Simultaneously with the metamorphites the granite gneiss shows a successive reconstitution of the fabric in approaching the prophyritic granite, and whether they retain the cataclastic structure or not, close to the porphyritic granite the orientation shows complete reconstitution into an almost perfect **S** tectonite. The fabric of the quartz in the "granulite" is thus not due to mechanical flattening—as in such a case a similar fabric should be shown also by the cataclasites that occur close to the porphyritic granite.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF MEDICAL AND VETERINARY SCIENCES.

President :—Dr. V. R. KHANOLKAR, B.Sc., M.D. (Lond.)

Abstracts

1. Studies on synthetic anti-spasmodics. Part-I.

A. N. BOSE and SRIPATI BOSE, Calcutta.

Antispasmodics may be divided into two classes; (i) those (e.g. atropine) which act to prevent or abolish the action of stimulation of automatic nerves (neurotropic), and (ii) those (e.g. papavarine) which are not thus related to innervation, but act directly on the musculature (musculotropic). Since compounds which can combine both the types of action are likely to be more effective in clinical therapy, a number of new synthetic Quinoline and pyrazolone derivatives both containing tertiary amino groups, synthesised in this laboratory these have been subjected to pharmacological tests from three different aspects; (a) Screening for antispasmodic properties and cardio-vascular action, (b) Toxicology, and (c) their possibility as chemotherapeutic agents. The results of the studies so far carried show all the six compounds except III (6-acetyl amino-4-hydroxy-3-diethylaminomethyl-2-methylquinoline) exert definite antispasmodic action at 50-200 yon isolated guineapig jefunum pieces. The compound III exerts rather a spasmodic effect. The compound I (1-phenyl-3-methyl-4-piperidino-methyl-pyrazolon) and VI (2-Methyl-3 diethylaminomethyl 4 hydroxy quinoline) appear to exert both neurotropic and musculotropic action against Ba C½—induced spasms. On perfused toads' heart, I exerts a definite stimulation at a concentration of 1 in 100,000, with complete heart block at 1 in 10,000 Mixtures of different strength of compound I with carbachol when injected intravenously to chloralose cats, show definite antagonistic action of the drug against the vaso-depressor action of carbachol. Toxicologically I &II are the least toxic while IV, III and VI are of higher toxicity. None of the compound show any trypanocidal action.

2. Chemical composition of saps of Palm Trees.

K. N. BAGCHI and S. K. BASU, Calcutta.

1. 69 genuine samples of such saps, fermented and unfermented, collected from different varieties of palms from different places and under different soil conditions, were examined. They were collected with special care under the supervision of an officer of the former Bengal Govt. from the principal supply centres of toddy around Calcutta.

2. Saps of the three kinds of palm trees—cocoanut (Cocos nucifera) date (Phoenix sylvestris) and palmyra (Borassus flabellifera), were found to be practically of the same composition.
3. The composition, however, appeared to vary within certain definite limits for individual trees but was not otherwise influenced to any appreciable extent by factors like the season of the year, the sex or age of the tree, nature of the ground open which it grows (whether moist or dry, or whether high or low), its proximity to water, etc.
4. Gravity, sugar content, acidity and alcohol content were found to be important elements in the composition of a sap.
5. The gravity of a sap in the unfermented condition was found to closely follow the calculated "Original gravity" of the fermented sap. This "Original Gravity" which takes into account the degree of fermentation undergone by a sap sppeared to be a very dependable factor for determining its quality.
6. The average gravity of the saps appeared to lie in the neighbourhood of 1050.0 and in the case of a few samples collected in the hottest part of the year it was near about 1060.0.
7. The acidity of the fully fermented saps (not too stale) was near about 0.5% $\frac{W}{V}$ (as acetic acid) and that of the unfermented saps not above 0.1%.
8. The sugar content (as glucose) of the unfermented saps averaged 8-10% $\frac{W}{V}$ and in some cases it was as high as 13%.
9. The alcoholic strength of the completely fermented saps ranged between 8-10% v/v in terms of proof spirit (4.5-5.8% alcohol $\frac{V}{V}$) and in a few cases even above 11.0% proof.

3. Liberation of histamine by Cobra (Naja naja) venom from isolated diaphragm of the rat.

N. K. DUTTA, and K. G. A. NARAYANAN, Bombay.

It was reported by Rocha E. Silva and Schild and Schild that d-tuborcurarine and ammonia release histamine from isolated diaphragm of the rat. Pharmacological study of cobra venom carried on here indicated that it is also capable of releasing histamine from the isolated rat diaphragm. A quantitative estimation of the amount of histamine liberated was studied. The method fellowed was essentially the same as that of Rocha E. Silva and Schild. Histamine liberated from the rat diaphragm was estimated biologically on guineapig's ileum. The following tables show the amount of histamine liberated by cobra venom. The figures represent the mean of five experiments.

TABLE I.

Concentration of cobra venom per millilitre. --	10 μg.	25 μg.	50 μg.	100 μg.
Histamine released μg/g. of fresh tissue during 5 minutes. --	2.8	3.0	5.2	6.6

TABLE II.

Concentration of cobra venom per millilitre.	10 μg.	25 μg.	50 μg.	100 μg.
Histamine released μg/g. of fresh tissue during 45 minutes	9.57	9.26	13.85	17.28

It is evident that cobra venom is a potent liberator of histamine.

4. Extraneous matters in biological materials, (Viscera, Vomit etc).

Dr. S. K. CHATTERJ,I and Sr H. D. GANGULI, Calcutta.

Biological materials (human viscera, vomit etc.) are usually sent to this department in connection with criminological investigation for detection of poisons.

As the poisons are many and various the analytical work is done on some fundamental principles and in a definite order. When no poison is detected the case is reported as a negative one.

It is rather an interesting phenomena that in these cases reported as positive or negative, the remnants of the stomach contents and vomited matters when examined more carefully would reveal many extraneous matters which may not be of interest from academic point of view but may be of interest for clinical point of view.

Out of 125 such cases the contrifuged deposits of the remnants of the liquid contents of the stomach and vomited matters when examined, 18 of them were found to contain deposits of silicate matters with all kind of hairs and fibres. These have been given in a tabular form.

The sources of these extraneous matters must be any of the following:—

(a) from the food stuff and cooking materials (natural source).

(b) addition of these matters in the food stuff with intention to create mischief.

(c) or due to unclean vessels used for preserving the materials.

As a remedial measure the following steps may be followed:—

(a) The public health department, dealing with the administration of foods and drugs in country, should by law condemn those food materials containing a high percentage of these extraneous matters and allow prosecution of the dealers.

(b) The receptacles in which these medicolegal exhibits are preserved and sent for analysis should always be thoroughly washed and cleaned before use.

(c) The medicolegal experts should also keep in view the possibility of the presence of these extraneous matters in the stomach contents of an individual and always look for ehem in addition to the poisons as a routine method. This may reveal something from the criminological point of view and may be helpful in the prosecution of the case.

5. The progress of Plasmodium gallinaceum infection in native fowls.

A. N. BOSE, and N, K. ROY, Calcutta.

In connection with an antimalarial research work under a grant from the Council of Scientific and Industrial Resetrch, we had to collect a strain of **Plasmodium gallinaceum** from the Malaria Institute of India. The same strain is being maintained for more than eight months and the progress of infection in control birds being noted below:—

1. The progress of ptrasitemia in native fowls procured from the local market and infected with plasmodium gallinaceum have been studied on 116 birds with reference to their weight, sex, parasitedensity, survival period and erythrocyte counts.
2. Birds of weight varying from 401-600 gms are being found more suitable from the point of high parasetemia and survival period.
3. A very large percentage of inoculated fowls are being found to develop only a scanty infection.
4. Majority of birds showing high parasitemia are being found to reach the peak within 8 days of inoculation.
5. Injection of glucose significantly enhances the parasitedensity of birds with scanty infection.
6. A number of birds show some immunological resistance and a state of premunity.
7. A rapidly developing anaemia is found to be associated with the development of infection.

6. A case of accidental poisoning (non fatal) by taking ground nuts (chinabadam).

S. K. CHATTERJEE and H. D. GANGULY, Calcutta.

A case of accidental poisoning of a little girl by taking ground nuts (chinabadam) has been reported. A trace of hydrocyanic acid and an aldehyde (benzaldehyde), the common constituents of bitter tlmond, peach kernels, cherry leaves, have been detected in the stomach wash of the girl, sent for chemical examination. The child's life was saved after proper treatment. Medicolegal experts should keep this in view in reporting such cases of accidenttl poisoning from food stuff.

7. Allergy in Skin Diseases.

G. PANJA, Calcutta.

Examples of allergic skin diseases, their incidence, influence of heredity and season, causes—exogenous and endogenous, association with eosinophilia, liver function, Oriel's proteose and asthma and effect of various treatment have been given and discussed in the paper.

7a. Our first and Foremost approach to the Prophylaxis of Leprosy in India.

G. PANJA, Calcutta.

On careful examination and questioning of a large number of cases conducted personally but the author, it has been found that knowledge about leprosy, its initial lesion and mode of infection are entirely lacking in most of the cases, though a high percentage of the victims are educated. Time that elapses between the appearance or detection of the initial lesion and consulation with a medical man varies from one month to over ten years. The disease is neglected in a very high percentage of cases, for about 2 years in about 25% of cases and for 5 yetrs in about 15% of cases. From undiagnosed and neglected initial stage (nm_1) type, about 20% developed into lepromatous or tuberculoid stage. In about 30% of cases, medical men, are to blame for non-diagnosis of early cases.

Our first and foremost duty in prevention of leprosy should be therefore an intense educative propaganda conducted in a practical and effective way and other steps that are laid down in the paper.

8. Studies on Poona Flies 1.

D. R. RANAD...... and P. J. DEORAS, Poona 4.

Actual collection of Muscid Flies of Poona were done for one year at five localities. These localities included Dairies, Residential houses, Drains, and Bazars. Eighteen species of Muscid flies have been caught. The most predominant fly being **MUSCA NEBULO. F.** Temperature and Humidity conditions were also recorded. It is seen that there are two peak periods when the flies are in large numbers. These being in July and March. The number of females caught were more or less larger than males except during the months of the peak period, when the males were in the same numbers as the females. The male and female ratio varied from locality to locality.

9. Gestation periods of Indian Breeds of Cattle—II.

P. BHATTACHARYA, S. S. PRABHUS and S. N. CHATTERJEE, Izatnagar, U.P.

The following gestation periods 10 days, were observed for male and female births in the undermentioned additional breeds of Indian Cattle.

Hariana	♂♂	288.66	♀♀	286.78
Kankraj	♂♂	289.52	♀♀	286.81
Ongole	♂♂	289.73	♀♀	287.40
Kangayam	♂♂	288.21	♀♀	285.35
Amrit Mahal	♂♂	287.25	♀♀	285.07
Hallikar	♂♂	290.14	♀♀	288.72
Bhagnari	♂♂	289.67	♀♀	288.16
Mewati	♂♂	289.25	♀♀	287.80
Rath	♂♂	286.06	♀♀	288.91
Bred Hariana	♂♂	287.61	♀♀	286.32
Other Breeds	♂♂	284.36	♀♀	282.81

The difference between breeds as well as between sexs was statistically highly signifilant. Analysis of farm-wise data pertaining to one breed namely **Hariana** showed statistically significant difference between farms, between gestations, between sexes. The interaction sex Farms was also significant at 5% level. These results have been interpreted as showing genetic impurity of the stock maintained at the four different farms. The animals have all been classified as belonging to a single breed.

10. Secondary "Sex-ratio" of normal births in Indian Cattle—II.

P. BHATTACHARYA, S. S. PRABHU and S. N. CHATTERJEE, Izatnagar.

A total of 6228 calving records from 2032 cows belonging to nine pure and two grade breeds of cattle from fourteen different farms in the Indian Union were considered. The overall average "sex-ratio" worked out at 100.16 males per 100 females which was less than that previously observed for the seven pure and too grade match breeds. The breed wise "sex-ratios" are as follows:—Hariana = 9465: Kankrej = 107.52; Ongole = 94.46; Kangayam = 102.75; Amrit Mahal = 86.36; Hallikar = 114.56; Bhagnari = 87.50; Mewati = 100.00; Rath = 154.55; Cross-bred Hallikar = 119.17 and Other Cross breeds = 96.08 males per 100 females. The gestation-wise sex ratios are as follows:—I = 96.12; II = 105.95; III = 98.26; IV = 107.14; V = 87.92; VI = 85.51; VII = 99.28; VIII = 113.79; IX = 109.26; X = 93.94 males per 100 females.

For want of data the test of significance of differences in "sex-ratio" between breeds within each gestation could not be carried out while the tests carried out revealed no significant difference in "sex-ratio" between both gestations and between breeds.

11. Field Application of Artificial Insemination in India—III.

P. BHATTACHARYA and S. S. PRABHU, Izatnagar, U. P.

This is the third report on the field application of artificial insemination in India to be communicated to the Science Congress and deals with 6450 inseminations performed on cows and buffaloes from a total of 743 collections taken from 31 bulls stationed at Patna, Calcutta and Bangalore, artificial Insemination Centres during the year 1948. The bulls of the **Bos indicus** breeds gave on an average 4.31 cc. of semen from which on an average 10.75 animals were served with an average fertility of 67.36% or 1.48 services per conception, while the respective figures for the bulls of the Bos bubalis breed were 2.69 cc, 3.61, 68.53% or 1.46. The largest volume of semen was recovered from bulls of the **Gir** breed (9.01 cc.) and the largest number of animals inseminated per ejaculate was 24. These figures compare favourably with the previously reported figures and clearly demonstrate the growing popularity of A. I. service. It is of interest to note that while the total number of collections was practically the same as in the previous report, the number of animals inseminated had nearly doubled.

12. Studies on Sex behaviour of trtificial Insemination Bulls—I.

S. S. PRABHU, and P. BHATTACHARYA, Izatnagar, (U. P.)

Studies were conducted on six buffalo bulls belonging to a type commonly found in U. P. The experiment was designed to test the difference if any, in the reaction time and characteristics of semen collected from trained bulls when shown anoestrus and oestrus (artificially induced) "dummies". Results are negative showing that as far as the buffalo bulls are concerned, in all probability, their sex behaviour is not materially affected by the condition of the dummy shown.

13. Seasontl Variation in Conception Rates in Artificially bred cows.

S. S. PRABHU, and P. BHATTACHARYA, Izatnagar, (U. P.)

Conception rates of 2,596 cows inseminated at Calcutta and 5,854 cows inseminated at Patna during the years 1946-48 and 1,284 cows inseminated at Bangalore in the months of April to December, 1947-48, have been analysed with with a view to detect the existence of seasonal trend, if any. The results indicate the absence of any seasonal trend which has been interpreted as due to the use only of semen samples of approved quality for insemination. An year to year and a centre to centre significant difference in conception rate, however, has been observed. This has been explained as possibly due to the acquision of operative skill by the artificial insemination personnel coupled with their own individuality.

14. Effect of lower protein level in ration on semen production and reaction time of Buffalo Bulls.

S. S. PRABHU. K. D. BHAYA and P. BHATTACHARYA, Izatnagar, U. P.

An experiment was conducted on nine buffalo bulls of a type commonly met in Uttar Prtdesh. They were divided at random into three groups each of which was allotted at random to the three treatments which consisted of feeding of concentrates containing 100%, 75% and 50% of Morrison's dry-cow digestible protein requirement. Semen was drawn at regular weekly intervals tnd on each day of collection two ejaculates in rapid succession were taken and studied separately. In all twelve items were studied and compared. Comparasions were instituted at the end of three and a half months duration of experiment and showed no statistically significant difference between treatment groups in any of the twelve different items studied. This appears to suggest that deficiencies upto the extent of 50% of Morrison's dry cow digestible protein requirement could be fed to breeding bulls for three and a half months without detriment to semen production and reaction time. Apparently, there are sufficient resources in the bull's body to meet the short term deficiency in digestible proteins.

15. Effect of short term feeding of vitamin A deficient rations on the reaction time and semen qualities of breeding Bulls.

S. S. PRABHU, U. D. SHARMA and P. BHATTACHARYA, Izatnagar, U. P.

Short term feeding trials were conducted on eight Kumauni Hill bulls with rations deficient in Vitamin A. All the bulls were put on a ration which consisted of dry Hay and a concentrate made up of two parts,—Crushed oats and one part linseed cake. Half of the bulls however received in addition 50 I. U.

of Vitamin A per lb. (live weight) supplied through a highly concentrated Vitamin oil. This group acted as controls. Semen was collected from all bulls at weekly intervals with two ejaculates taken on each day of collection in rapid succession and studied for eighteen different semen characteristics and reaction time. Analysis of the data showed no statistically significant difference in semen characteristics and reaction times of bulls in the control and treatment groups showing that sufficient reserves of Vitamin A exists in the body to meet short term deficiencies in rations.

16. Effect of Pregnant mare Serum Gonadotrophin (PMS) on anoestrous Buffalo.

S. N. LUKTUKE and P. BHATTACHARYA, Izatnagar, U. P.

With a view to shortening the intercalving period which is usually very long in the Indian breeds of cattle, 32 she-buffaloes and 7 buffalo heifers were treated with PMS. The animals were found to have aneostrous ovaries at the time of treatment. PMS was administered subcutaneously and the dosage varied from 750 I. U. to 4,500 I. U.

Out of the 39 animals, 24 animals were slaughtered 6-26 days after treatment. Most of the animals in this group exhibited symptoms of heat 2-9 days after receiving injection. Ovulation occured in 16 animals. Twin ovulation occured in one buffalo. Ovum was recovered from six animals.

In 15 other animals, oestrus usually occured 3-7 days after treatment. As a result of service at the induced heat 8 buffaloes became pregnant. One buffalo became pregnant when inseminated at the subsequent heat. One heifer did not show any response to treatment. Oestrous cycle was restored in only one cow out of the remaining five.

17. Investigation on inducing sterility in Scrub Cows.

S. N. LUKTUKE and P. BHATTACHARYA, Izatnagar, U. P.

Induction of sterility in scrub cows is a problem of major importance in Animal Husbandry of India which if solved will go a long way in the improvement of the cattle industry.

In the present investigation, 15 cows with functioning ovaries were divided in 3 groups of five each. Thermo-cautery was performed on Os Uterus of the animals in the first group. Animals in the second group were injected with a single massive does of PMS (7500 I. U.—10,000 I. U.). Each cow in the third group received a subcutaneous dose of 5000 I. U. of PMS, second day after the removal of corpus luteum. The injections were repeated four times at an interval of 25 days. It was possible to suppress oestrus and ovulation temporarily by administration of massive doses of PMS. Further investigations on this problem are necessary.

18. Preliminary observations on splenectomy and piroplasmosis in cattle.

PHILIP A. HAWKINS*, H. N. RAY and G. A. SHIVANI, Izatnagar.

Splenectomy temporarily impairs the defence mechanisms of the animal body and makes possible the detection of latent infections. During the course of this investigation in cattle latent infections with **Babesia argentina, B. bigemina** and Anaplasma marginale have been demonstrated.

In three splenectomized calves B. argentina or **B. bigemina** appeared in the peripheral circulation three days after splenectomy. Their appearance was followed by a slight rise in temperature. The period of patency persisted for three to four days, in the case of **B. bigemina,** after which the organisms appeared irregularly in small numbers. The largest number of organisms observed was 140/10,000 red blood cells. **Babesia argentina** occurred in small numbers and irregularly.

One calf was observed to be infected with **Anaplasma marginale** 14 days after splenectomy. The numbers gradually increased to 3200/10,000 red blood cells. The period of patency has not yet been determined.

In one calf previously infected with **Theileria mutans** through **Hyalomma savignyi,** splenectomy resulted in a marked increase in the number of parasites. Before the operation there were 10/10,000 red blood cells, whereas 22 days later the organisms had gradually increased to 300/10,000 red blood cells.

19. Eimeria Smithi as a cause of coccidiosis in cattle of the Bombay State.

Dr. S. R. RAO, Bombay.

Eimeria smithi as a cause of coccidiosis in the cattle of the Bombay has been reported for the first time.

A brief discription of the parasite is given and it has also been noted in this paper that infections are always due to either **Eimeria zurni** or **Eimeria smithi** but on no occassion a mixed infection due to both has been seen.

The author puts forward a plea that more intensive work should be done to find out the relative pathogenecity of the two parasities that have been reported from this country by following up to the endogenous stages. Unfortunately no work seems to have been done in this line in this country.

20. Schistosomiasis Dogs in Bombay State.

Dr. S. R. RAO, Bombay.

Four cases of Schistosomiasis in dogs have been recorded in this paper. In all three species of schistosomes namely **S. indognitum, S. indicum** and **S. spindalis** hvae been associated with dysentric condition in dogs. This is the first time that **Schistosoma indicum** and **S. spindalis** infection is recorded in dogs besides **S. incognitum.** A thorough search might reveal its occurance in those areas from which it has not been reported so far. The value of dogs as experimental animals for the study of animal and human Schistosomiasis is emphasized.

21. Egg production in different breeds of poultry.

S. G. IYER, G. M. V. C., Izatnagar, U. P.

Observations have been made on the laying performances of four different breeds of poultry during a period of one year under uniform environmental conditions. The records revealed that the White Leghorns matured earlier than the Rhodes but the average annual egg production in the case of Rhode Island Reds was superior to that of the White Leghorns. On the other hand, the average egg size was slightly superior in the case of White Leghorns. The average egg production and egg size in the Indian fowl were relatively low. Even in the first generation the laying performance of Barred Plymouth Rock, a breed most popular in U. S. A. seems to be satisfactory.

22. Hatchability in different breeds of fowls.

S. G. IYER, G. M. V. C., Izatnagar, U. P.

In studies on hatchability the influence of different breeds and crosses under Indian conditions seems to have economic significance as the graded stocks gave somewhat better hatchability than those of the parental breeds. In the case of an improved strain of Indian fowl inbred over ten generations the hatchability was relatively low and the strain is being improved by the introduction of progeny tested sires into breeding pens.

23. The role of turning in relation to hatchability.

THAKRAL, B. M. NARAYANAN, S. and IYER, S. G. Izatnagar, U. P.

Various physico-chemical factors affect hatching results. Though numerous experiments on the relative importanec of turning of eggs during artificial incubation have been carried out by Western workers, investigations on the necessity for turning before or after 14 days of incubation have rarely been conducted. Eggs have been set both in the small Silver Hen as well as Secura mammoth electric incubator. Preponderance of dead-in-shells were met with in the unturned experimental group of eggs and hence the hatchability results were relatively poor. It revealed that at least during the first 12 days of incubation turning was essential. Probably once the embryo had shifted on to long axis i.e. by the 14th day the hatchability was not affected even when the eggs were left unturned and the embryo development was normal and candling on the 18th day revealed fully developed embryos inside the eggs.

24. The influence of age of eggs on hatchability.

H. P. TANDON and S. G. IYER, Izatnagar, U. P.

Eggs should be incubated soon after they are laid, but this is a practical difficulty. Hatching eggs are therefore usually stored for different periods, according to one's circumstances. Experiments were made to find out the effect of age of hatching eggs on their hatchability.

Eggs stored at 60°F for a period of 7 days hatched better than those stored at the same temperature for longer periods. The decrease in hatchability up to 4 week's storage was gradual but marked. In the case of hatching eggs stored at 75°F for 8-to-10 days hatchability was relatively poor. The age of egg prior to incubation therefore is an important factor influencing hatchability.

25. The processing of Cow manure for increased egg production.

S. BOSE, B. M. THAKRAL and S. NARAYANAN, Izatnagar, U. P.

In these days of acute food deficits the feeding of fowls is the greatest problem in towns and cities. A simple method for processing cowmanure for increased egg production has been evolved. The processing of cowmanure was carried out by stirring the airdried manure with 10 times its weight of water for half an hour, filtering through linen cloth and finally washing the residue with water. The laying trial experiment revealed that the birds fed with mash containing the water extracted residue of cowmanure gave significant increase in egg production, as compared with the control group. The inclusion of the water extract from cowmanure in the mash, on the other hand, had a depressing effect on egg production. The average body weight and food consumption of the experimental birds did not, however, show any significant differences. The poultry keeper can therefore salvage something good for his birds from cow manure.

26. Inheritance of Smut (Slaty) under colour in Rhode Island Red.

S. G. IYER, B. M. THAKRAL and S. NARAYANAN, Izatnagar, U. P.

In the breeding of Rhode Island Reds, such defects as white ticking in primaries and secondaries of wings or slaty under colour in some sections of the body are met with. The exact mode of inheritance of smut or slaty under colour is not known. Breeding experiments with smut and smut-free parental stock reveal that this character behaves in a dominant manner. Thus, the progeny from smut males mated to smut females will exhibit only slaty under colour. When the males or females utilised in the breeding pen possess smut, most of the progeny will reveal this defect. That more than one pair of genes are involved in the production of this character is revealed by the small incidence of smut in the progeny of parental stock free from smut. Further it has been concluded that this character is not sex-linked.

27. Infectious coryza of Fowls in India.

S. B. V. RAO and D. R. RAMNANI, Izatnagar, U. P.

The prevalence of Infectious Coryza in specialised poultry farms, all over India forms a serious menace of growing chickens, characterised by inflammatory lesions of the upper respiratory tract. An appraisal of the etiological factors was made. Coryzas caused by two independent disease-entities viz. (1) **Haemophilus gallinarum** and (2) a coccobacillary organism or a virus have been studied. Chemotherapy with Lugols Iodine, sulphamerazine and dettol were found to be inefficacious in the type of coryza described.

28. Growth rate in purebred and crossbred fowls.

S. G. IYER, Izatnagar, U. P.

During the course of breeding operations in 1949-50 maintaining different breeds and their crosses of fowls at the Poultry Research Section, Indian Veterinary Research Institute, Izatntgar, the results revealed that under Indian conditions chickens could be reared with low mortality losses under a suitable environment. Further the body weights at 8 weeks were nearly the same whether the breed was White Leghorn or Rhode Island or Inditn fowl which is notorious for small body size. But due to the genetic trait, at 24 weeks of age, the body weights of the various breeds in descending order stand as under: Rhode Island Red, White Leghorn and Indian fowl. The influence of cross breeding with the manifestation of heterosis is obvious in the case of the graded chickens of both the White Leghorn and Rhodes. The results of growth rate studies suggest that suitable age for selling chickens for meat is between 16 and 24 weeks of age as, after this period, the growth rate declines and the stock, if intended for table, would only remain a liability.

29. The determination of quality in eggs, based upon the physical and chemical characteristics of the eggs.

S. BOSE, A. K. PAL, T. D. MAHADEVAN and R. NARAIN, Izatnagar, U. P.

Experiments were carried out to determine the quality in untreated and heat-treated eggs stored at 60°F and 70 per cent relative humidity for 4, 8 and 12 weeks respectively. The heat-treatment greatly improved the keeping quality of eggs, the effect being very much greater on albumen than yolk quality. Quality, as ordinarily determined by candling and based primarily on the aircell size of unbroken eggs, was not found reliable for indicating the quality of the opened eggs, especially for the heat-treated eggs. The albumen index and yolk index really indicated the degree of the deterioration of the quality in eggs.

The composite samples of the liquid whole egg, liquid white and liquid yolk did not show any significant differences in their content of different protein fractions and phosphorus during the experimental period, the variation of the moisture content being the most important change which occurred during storage. The rate of diffusion of water from the white into the yolk during storage was more rapid for untreated than heat-treated eggs.

The mean molecular weight of the fatty acids in eggs were found to be somewhat higher than that of butter. The saponification values and iodine values of the egg fat of the untreated and heat-treated eggs showed a progressive increase during storage. This was probably due to more complete extraction of lecithin and cephalin due to their progressive loosening from their adsorption compounds on storage. Further work on chemical methods for determining quality in eggs is needed.

30. Treatment of equine surra in India with Antrycide Methyl Sulphate.

Dr. H. N. RAY, and G. A. SHIVANI, Mukteswar-Kumaon.

Results of a few laboratory trials carried out at Indian Veterinary Research Institute Mukteswar to see the curative effect of Antrycide Methyl Sulphate (a new I. C. I. preparation) in the treatment of equine surra are discussed in this article. Two ponies artificially infected with **Trypanosoma evansi** responded very well to the treatment with antrycide methyl sulphate and blood of these ponies remained negative for trypanosomes by three tests viz., (i) microscopical examination; (ii) biological test; (iii) complement fixation test, upto the period of 3 months after which they were discontinued from experiment. One infected pony when treated with antrycide methyl sulphate in the secondary stage of the disease also recovered completely and its blood was negative to all the tests for a continued period of observation for 3 months. 18 natural cases of equine surra were also treated successfully with this drug. This drug has special advantages such as; it is less toxic, can be administered subcutaneously, and has a wide latitude of dosage.

Antrycide holds out a great promise in the eradication of surra from the Indian soil.

31. Treatment of Alopecia areata by intradermal injection of Milk and Methyl Acetyl Choline.

D. PANJA and A. K. BANERJEE, Calcutta.

300 cases of Alopecia areata were treated with intradermal injection of milk. The milk used in those cases was first churned to remove the fat partially and then sterilized in autoclave. The alopecia patches were injected intradermally by many close punctures about ¼″-½″ distance, the dose being 0.1 c.c.—0.3 c.c. in each puncture. The interval of injection was between 7-15 days. The treatment of the alopecia patches was successful in majority of cases within a short period.

Another set of alopecia areata cases was also treated by intradermal injection of Methyl Acetyl Choline in the same doses but the result was not satisfactory as the milk injection.

32. Infantile allergy in relation to scabies.

D. PANJA and A. K. BANERJEE, Calcutta.

More than 500 cases of Infantile eczema were observed during the period of five years. One form of eczema usually begins on the head or face. At first it is papular, then vesicular and later moist, oozing and crusted. Gradually the eruptions spread over the ears, down the neck and in severe cases the whole body and limbs are affected. The itching is severe and periodical in nature, in both nights and days. The disease appears during the teething age, i.e., between 6 months to 3 years of age. Some of the cases of this variety may be originally due to Seborrhoea of the scalp, 'milk crust'.

Another form which comprises the major number of cases appears first on extremities as papular measle like eruptions even between fingers and toes. The rashes rapidly spread and become generalized within a few days. Gradually they become vesicular and pustular and later eczematos. The itching is present and worse in nights only. The disease appears even in babies of 5-10 days of age. In all cases there is definite history of scabies in the family; parents; brothers, sisters or servants are affected with scabies. So the observation shows that scabies is a predisposing factor in majority of cases of Infantile eczema. Acarus scabei was isolated from a few cases only and it may be possible that the association of mite produces a mite allergy in infants. Early and extensive adequate treatment of the infants and of all associates with scabies infection controls the Infantile eczema quickly.

33. Nocardiosis of the skin and subcutaneous tissue in Bengal.

D. PANJA and A. K. BANERJEE, Calcutta.

About 90 per cent of the cases of Actinomyces are due to the infection by the anaerobic variety (A. bovis). There are several reported cases of infection of Nocardia (anaerobic species of actinomycetacae) of the skin, subcutaneous tissue and of the lung; and this is the only case reported from Bengal. The clinical picture of the case obtained was a hard indurated mass of 3 years duration. There were multiple nodules some hard, some soft and fluctuating on the abdominal wall and ulcers and sinuses were also present on the mass with foul smelling purulent discharge. The entire mass was moveable but not freely and was not adhered to the abdominal wall. There was no grannules and Nocardia was repeatedly isolated from open and closed lesions of the skin. The case has been studied thoroughly.

Quite a large number of therapies starting from the older form of treatment with iodides to the recently advanced chemotherapeutics and antibiotics were tried one after the other without any response.

34. Isolation of V. Chelerae from house flies from a Cholera Ward.

S. K. GUPTA and S. C. GHOSAL, Calcutta.

Flies have long been popularly believed to act as mechanical carries of **V. cholerae,** thereby causing dissemination of cholera. But all the investigations to prove this point by actual isolation of cholera vibrio from house flies under natural condition, had been done at a time when the criteria of indentification of V. cholerae were not properly understood. The present work, was, therefore, undertaken to find out the incidence of cholera vibrio in flies caught in a cholera ward during an epidemic of cholera in Calcutta last year. These were examined in batches of 12 or 13 and both the external surface and the interior of the flies were examined separately. Twenty-four such batches were examined. No **V.** cholerae was isolated from the external surface whereas 37.5 percent of the batches showed cholera vibrio in the interior of the body.

Significance of this finding is discussed.

35. Urgency of sulphone treatment in some neural cases of leprosy.

Dr. S. N. CHATTERJI, Calcutta.

Usually lepromatous cases get the first chance to have sulphone treatment and neural cases receive chaulmoogra treatment. Although the neural cases improve well with injections of chaulmoogra oil yet there are some cases whose condition become worse inspite of this treatment. In this article it has been described in detail the conditions where sulphone treatment was urgently needed.

36. Observations on the toxicity of White Oil.

R. N. CHAUDHURI and N. K. CHAKRAVARTY, Calcutta.

We have come across a few cases of epidemic dropsy in persons who took no mustard oil for months or years. This made us think of the role of other factors in the causation of epidemic dropsy. In order to find out if there may be any other adulterant of edible oils other than Argemone oil which is toxic and which may possibly explain these cases we have started testing other cheap oils on monkeys. While oil is cheap, colourless or faintly yellow, tasteless and odourless being thus very suitable for the purpose of adulteration.

So far the oil has been tested on three animals to all of which is proved to be toxic. A lethal effect was produced in two animals in 10 and 21 days. The toxicity, however, appeared to vary with two samples tested. Congestion of the internal organs was the chief feature on post mortem examination. Detailed histological study carried out in one monkey showed marked dilatations of blood vessels in the skin, choroid layer of eye, heart, lungs, kidneys, liver. adrenal gland and mesenteric lymph nodes. Some of the organs showed actual haemorrhage. There were a number of discrete small ulcers in the mucosa of large intestine, The other two animals also showed similar picture but there were no intestinal ulcers.

The similarity of these lesions with those of argemone treated monkeys is very striking. It is suggested, on the basis of this finding, that consumption of white oil as an adulterant of edible oils may be a factor in the causation of epidemic dropsy.

37. On a new factor in Liver preparation.

A. N. BOSE and S. GHOSH, Calcutta.

In attempts to develop a suitable liquid medium for microbiological assay of vitamin B_{12} in Liver preparation with a strain of Lactobacillus leichmannii, it is being found that the amount of response given by a proteolysed Liver extract is significantly higher than what was expected from its vitamin B_{12} content. In different media, which were otherwise complete in all respects except vitamin B_{12}: the strain was found to give with standard vitamin B_{12} a type of growth which was not strictly proportional to dose, and hence considered unsatisfactory. But with the same media and the strain, proleolysed Liver Extract gave a definite proportional stimulation of growth with increasing dosage at a high dilution. The nature of the growth response suggests the presence of some unknown factor, present in the proteolysed liver extract, which, apart from its vitamin B_{12} content, can serve as a specific growth factor for **Lactobacillus leichmannii** (local strain).

38. Clinical trial of M-5943 (A new Chloro-Derivative of Paludrine).

R. N. CHAUDHURI, M. N. RAI CHAUDHURI, and B. N. DUTTA, Calcutta.

Clinical trials with M-5943 (I. C. I.) was carried out on 28 vivax, 2 falciparum and 2 malariae infections. M-5943 is a new synthetic compound, N.—(3 :4'—dichlorophenyl isopropyl diguanide) reported to be much more active than paludrine against both the blood forms and exoerythrocytic stages of **P—gallenaceum** and **P. relictum**... The two regimes were used—(a) 2 tablets (20 mgm base) t. d. s for 10 days and (b) 2 tablets (20 mgm base) t.d.s for 7 days followed by 2 similar courses of 5 days at intervals of 5 days. The immediate effect on temperature and parasite was studied. The asexual parasites disappeared from the peripheral blood by the third and fourth day of treatment in 63% and 83% cases respectively. The corresponding figures as regards fever are 64% and 93%. Asexual parasites were however found even up to fifth day of treatment in 2 cases (6%) and fever in one case (3%). The gametocytes were apparently unaffected by the trtatment. In one quartan case they were seen upto the 8th day of treatment. Among 16 of the patients (13 of regime A and 3 of regime B) kept under observation from 3 to 6 months, there were 5 parasitic and one clinical relapses in regime A and one parasitic relapse in regime B. The interval between the completion of treatment and second attack varied from 41 to 74 days. Re-infection, of course, could not be definitely excluded. Some untoward reactions—such as vomiting, pain in abdomen, giddiness, dysuria, etc., were noticed in 9 cases. Thus in treatment of malaria it appears to have no advantage over paludrine and other commonly used antimalarials.

Absorption and excretion of M-5943:

The excretion and absorption of M-5943 were studied, using the method of Spinks (1949) based on the modification of the original hydrolytic method for the determination of paludrine (Spinks & Tottey 1946).

A study of whole blood concentration of M-5943 was possible in a very limited number of cases as about 40-50 cc of blood was needed for each estimation. In once case receiving regime B, the drug level in the blood was determined on the 4th, 6th, and 7th day four hours after the first morning dose and the values were 88, 175 and 200 u gm per litre respectively. The estimation was also done in the same patient on the following day just after the completion of the last 5 day course and the value was 71 microgrammes per litre. In another case with regime B, the concentrations per litre on the 2nd, 4th and 7th day were 150, 182 and 200 microgrammes. With single dose of 60mgm the drug concentration after 4 hours was found to be 80 u gm per litre.

The total urinary excretion of the drug varied from 23 to 35 percent of the administered dose. The drug disappeared from the urine in 6 to 10 days with regimes A & B and in 4 days with the single dose.

39. Theileriasis in cattle in Bengal.

M. R. SEN, Calcutta.

Theileriasis amongst animals has not received much attention, though the disease is widely distributed and causes anaemia and emaciation in adult cattle and heavy mortality in calves. During investigation of some outbreaks of acute Fasciolosis, examination of blood smears from emaciated cattle of the locality, revealed small protozoan parasites mostly rod shaped in about 80% of them. In well nourished cattle, such parasities were rarely detected after careful examination. Recently, large number of similar parasites have been detected in blood smears of 28 diseased and 7 dead calves examined, at a Pinjrapols Society, where over 200 calves died in course of 3 months and most of them seem to have died of this infection. Babesan, I. C. I., so far tried, appears to exert some benefecial effect upon the course of the disease. The disease in cattle seems to be more common in Bengal than hitherto beleived.

40. The Aetiology of Eclampsia and Pre-Eclamptic Toxaemia.

A. P. CHAKRAVORTY, Calcutta.

The present paper begins with a brief review of the current theories on the toxaemias of later months of pregnency. That the disease occurs only in the later months of pregnency indicates that either the placenta, decidua or the baby is involved. But the occurrence of the disease even when the baby is destroyed as in vesicular mole cases and also in some cases few hours after the delivery of the child (e.g., in post-partum eclampsia) suggest that the placenta or decidua or both are primarily at fault.

The investigations reported in this paper were carried out with a view to test the validity of placental origin of some so-called toxin for the production of this syndrome. A careful study of some 200 placentas suggest that placental infarction and retroplacental-haematoma which are said to be the source of the hypothetical toxin for causing the disease, is no longer tenable. The two conditions appear to be the effects rather than the cause of the disease. But once these are produced they act as an additional source of the toxin and thus keep on the vicious circle. The author, therefore, feels that more attention should be diverted on to the local factor (i. e. placenta and decidua) which is of great fundamental importance in the aetiology of the disease.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF PHYSICS

Abstracts

PRESIDENT: DR. S. RAMACHANDRA RAO, M.A., Ph.D., D.Sc.,

1. Effect of Humidity on Human Hair.

L. D. MAHAJAN, Patiala.

The effect of humidity on the human hair has been investigated. It has been observed that the human hair expands more than the animal hair by the increase of humidity of the surrounding air, or medium. This property depends on (1) the nature of the hair, (2) climatic conditions under which the hair has been brought up, and (3) the age of the hair or the age of the person to whom the hair belongs.

The young hair of cold and wet climate shows greater increase than the old hair of the hot and dry climate.

2. Intermolecular Force and Coefficient of Self-Diffusion.

B. N. SRIVASTAVA *and* M. P. MADAN, Lucknow.

In this paper the Chapman-Enskog theory of non-uniform gases, as applied to the phenomenon of self-diffusion has been utilized to evaluate the intermolecular force constants. The collision integrals occurring in Chapman-Enskog formulae for self-diffusion as evaluated by Hirschfelder, Bird and Spotz by assuming the 12:6 power form of the Lennard-Jones potential function have been used. The temperature variation of self-diffusion has been utilized to obtain the constant ε of the Lennard-Jones function, which represents the maximum (negative) energy of attraction of two molecules. The intermolecular separation γ_0 for zero interaction energy occurring in the same potential function has been calculated by actual substitution. The recent self-diffusion data of Winn, Winter and others have been used to obtain these constants and their values compared with those given by Hirschfelder, Bird and Spotz from viscosity and virial coefficient data.

3. A Study of the Motion of a Solid Sphere through a Liquid Column.

K. R. CHAUDHARI *and* D. V. GOGATE, Baroda.

When a small solid sphere like a ball bearing is allowed to fall through a long column of a viscous liquid contained in a wide glass tube, the sphere attains a critical (terminal) velocity almost immediately after it is dropped in the liquid provided that the sphere starts with a zero initial velocity from the top of the liquid column. If however spheres of larger radius and greater mass are used, they attain the terminal velocity only after falling through an appreciable length of the liquid column. The exact position of the plane in liquid column at which the terminal velocity is attained can be accurately determined by plotting a graph of time against distance (*i.e.* velocity curve) for different spheres. These graphs (velocity curves) are generally straight lines and show departure from linearity only at the point where the terminal velocity ends. This point is critically studied in this note and it is shown that when larger and heavier spheres are used the velocity curves are no more linear but assume a wavy form. The same effect is observed when light and tiny solid spheres like ball bearings, which ordinarily give a a linear velocity curve, are dropped into the liquid from different heights above the top of the liquid column so that when they reach the free surface of the liquid they start from there with a finite initial velocity. The form of the velocity curve obtained under these conditions is then examined and discussed.

4. The Effect of Fluid Motion on Heat Transmission.

D. G. KAPADNIS.

Using the method of dimensional analysis a partial theoretical expression, co-ordinating experimental data, in a general case of heat dissipation by forced convection is derived and it is applied to the particular cases of heat loss with air velocity and that with the characteristic dimensions of the vessels. The expressions derived for these special cases are in good agreement with the experimental results showing clearly that the heat transmission does not increase quite so fast as the air velocity,— the rate of heat transmission is proportional to 0.517th power of air velocity—, and that as the characteristic dimension of the vessel is reduced its convective heat transfer rate per unit area increases.

5. Graphical Solutions to Wave Interaction Problems in Gas Flow.

S. N. B. MURTHY.

Gas dynamical problems generally resolve themselves into partial differential equations of the hyperbolic type. The case of non-uniform unsteady flow of a gas in a cylindrical pipe can also be dealt with in the same way. In adopting this method a Legendre transformation has to be carried out, the mathematical method then generally becoming cumbersome. Assuming the gas perfect, it has been shown by Hugoniot that the differential equation can be combined with the adiabatic condition for flow within as infinitesimal transition region. It has also been proved that within this region the gas may be assumed viscous while outside it is not.

On this basis the equation of continuity and of motion (Euler) have been combined to obtain a partial differential equation of the second degree for the case of non-uniform unsteady linear flow of gas. Hilda Geiringer ("Recent Advances in Applied Mechanics", Vol. I, Academic Press, 1942) has given a numerical computation using Lagrange's form of the equation of motion for the same case. A graphical solution has now been developed based on the method of characteristics given by Prandtl and Busemann (Naherungsverfahren zur Zeichnerischen Ermittlung von ebenen Stromungen mit Uberschallgeschwindigkeit, Stodola Festschrift, Zurich and Leipzig, 1929, pp. 499-509).

The partial differential equation obtained is to be abandoned in the case of a discontinuous motion according to the Rankine-Hugoniot theory. In other words the value of C remains constant as long as the changes in state are continuous but changes over to a new value C when it crosses a 'shock line' and remains constant again till it meets another shock line. Partial solutions have therefore been introduced in limited regions and a solution has been built up in the (t, x) plane by means of characteristic curves. In addition to this, the diagram of state (a, u) has also to be constructed to complete the solution.

Boundary conditions for a sudden and continuous change in the cross-section of the pipe, for a nozzle at the end of the pipe and for variation in the state of gas during flow have been introduced. Results obtained by this method have been shown applicable to specific examples of flow of exhaust gas from diesel cylinders through the exhaust valves into the pipe terminating in a nozzle.

The accuracy of computation can only be checked up by experimental results. The limits to accuracy appear to be in the assumptions to be made regarding the nature of the gas and external conditions that come to be in engine operation. The possibility of deriving solutions by such graphical computation appears to indicate a wider field of application for this method, perhaps to the case of axially symmetrical supersonic flow leading to the design of nozzles for producing a parallel jet.

6. Concepts of Reversible Variations, Entropy, etc. in a General Probabilistic Method.

M. DUTTA.

In the present paper, which is extension and generalisation of paper, (Dutta, 1951) of the author, a new purely probabilistic method has been developed for investigations of thermodynamic problems. The method, as developed here, is purely macroscopic, but all the results about the macroscopic nature can be very simply deduced through the specification of the form of weight-factors which can be kept unspecified in macroscopic discussions. It is also found that the general probabilistic approach, as proposed here to some important thermodynami · concepts, *viz.* the reversible variations, the first law of thermodynamics the entropy, gives clear insight to these yielding some new interesting informations.

7. Some Observations on Supercooling and Theory of the Liquid State.

P. K. CHATTERJEE, Howrah.

Attention is drawn to certain results about viscosity S.I.C. and other properties of substances in the supercooled state of a liquid reported by the different workers. And a criticism is given of Fürth's explanation of the variation of viscosity. Attempt is being made to clarify physical ideas about the nature and structure of the liquid state and some inadequacies of the whole theory as formulated by Fürth are discussed. It is suggested that the problem of the liquid state has got to be tackled by a statistical theory of the condensed phase taking the mutual intereactions between the particles into account as has been done by Born & Green.

Some general observations are made about the phenomenon of supercooling so as to have a better understanding about the same and emphasise some of its aspects. The possibility of an explanation in terms of a phase change of the second order is put forward. It is, however, pointed out that further experimental evidence should be available before the formulation of a satisfactory theory.

Various new experiments are then suggested for collecting informations about supercooling on various points and discussions are given as to how these informations might throw light on the phenomenon of supercooling and hence be helpful for the formulation of theories of the liquid state and of the process of supercooling.

Finally a close analogy existing between the supersaturated solution and a supercooled liquid is drawn out and it is suggested that experiments with supersaturated solution on similar lines are expected to throw light on the subject.

8. Entropy of Liquid Helium II.

P. D. Pathak, Ahmedabad.

A relation between entropy and temperature in the case of liquid helium II is proposed. It satisfies the $T^{5.5}$ law in the range 2.1° *k* to 1.4°*k* as observed by Kapitza and the T^3 law in the range 1.2°*k* to 0.2°*k* with Debye characteristic temperature $\theta = 15.5°k$ as observed by Pickard and Simon.

9. Liquid Helium II and Landau's Hydrodynamical Equations.

P. D. Pathak, Ahmedabad.

Owing to the reluctance shown by some workers to accept one of Landau's hydrodynamical equations, probably because it involves a thermal term, the processes have been reexamined by considering the thermal and the mechanical forces separately. The same equations have been obtained. The equations of conservation of mass and entropy have been assume o be correct.

10. Vibration, Rotation Spectra of Molecules.

S. K. K. Jatkar *and* **V. K. Phansalkar**, Poona.

The large number of infra-red and Raman spectra of polyatomic molecules are usually explained on the basis of numerous combinations of the fundamental frequencies and over-tones.

In the present paper we have shown that the molecular spectra of polyatomic molecules consist primarily of vibrational lines of the bands with the rotational lines due to space quantisation, thus the frequencies are given by the formula

$$\vartheta = \vartheta_0 \left(\frac{1 \pm h}{4\pi^2 I} \sqrt{\frac{J+1}{J}} \right)$$

where $2J+1$ represents the orientations of the molecules in the field.

In this manner the entire molecular spectra of Benzene Deuterobenzene, Carbontetrachloride and 1,1,1-trichloroethane have been explained. In the case of Carbontetrachloride and 1,1,1-trichloroethane, we get some more strong lines due to induction effect.

11. The Flame Spectra of Some Phosphorus and Sulphur Compounds.

V. Y. Rajopadhye, Poona.

The Flame spectra due to phosphorus trichloride and phosphine, were obtained. The latter was introduced in the stream of coal gas and fed to the Bunsen burner, the former was burnt in a spirit lamp as a solution in ethyl acetate. In both cases, PO bands β and γ systems, and PH bands were obtained. It is believed that the PH bands are being reported for the first time in a flame source.

The flame of hydrogen sulphide, H_2S (in alcohol solution) does not give any characteristic spectrum of sulphur. But when fed to the Bunsen burner (mixed with coal gas) it shows the bands due to CS and SO. The atomic lines of sulphur are not expected since they require a high energy (exceeding 9 volts) unobtainable in flames.

Sulphur chloride, S_2Cl_2, used in a solution of ethyl acetate, or when ether vapour is passed over it and burnt, yields only CS bands. HCO bands due to the solvent are seen.

but not those of SO which should appear in the same region. However, when coal gas is passed over it and fed to the burner, the bands of SO and CS are obtained.

Thionyl Chloride, $SOCl_2$, gives by the solvent method or when mixed with coal gas, both CS and SO bands. Sulphuryl Chloride, SO_2CL_2, was used along with coal gas method only, since it requires only a small amount of the liquid. It gave the same spectrum, viz. SO and CS bands.

Organic sulphur compounds show both CS and SO bands, with different intensity patterns characteristic of each. All these observations—organic and inorganic—are explained in terms of the probable flame reactions occurring in each case.

The CS bands were so far known only in the cool flame of carbon sulphide. They now seem to occur in every normal flame containing sulphur.

12. Spectroscopic Method for Determination of Electron Energy in Discharge.

N. R. TAWDE *and* G. K. MEHTA

Brasefield's spectroscopic method for the estimation of the mean energy of the electrons in the h.f. discharge in hydrogen gives values much higher (20-30 volts) than those obtained by electrical probe method (5-8 volts). This discrepancy has been explained to be due to the neglect of the energy distribution among the electrons. The intensity of any triplet or singlet line can be calculated by the method of numerical integration using Brasefield's excitation function curves and the mean energy of the electrons as found by probe method, assuming Maxwellian distribution. The ratios of the calculated intensities for the triplet and singlet lines are comparable to those found experimentally. The new curves representing the intensity ratios as a function of mean electron energy for a Maxwellian distributions show that a neglect of the velocity distribution of the electrons give very high values of the mean electron energy (for above the ionisation potential of the gas); but on the other hand, by proper considerations of the same we can get the observed intensity ratios for mean energies (as found by probe method) much below the excitation potential.

13. Effect of Pressure on the Excitation of Triplet and Singlet States in H_2 Spectrum.

N. R. TAWDE *and* G. K. MEHTA.

The variation in the excitation function of some lines in the triplet and singlet system has been noticed in the secondary spectrum of hydrogen with the variation of pressure at which the h.f. discharge was excited. The strong singlet system is indifferent to the changes in pressure while the strong triplet system $np^3\pi \rightarrow 2s^3\Sigma$ is distinctly enhanced at lower pressures. Merton and Barratt have noticed similar behaviour in powerful condensed discharge in hydrogen. This is contrary to the expectations from electron energy considerations, where the ratio of the intensities of singlet to triplet is expected to be larger at increased energy of the electrons at low pressures, when we assume the excitation functions to be independent of pressure. The excitation functions have been measured by Brasefield at a constant pressure of .03 mm. and are evidently not useful for higher pressures without considering the changes brought about by pressure. The part played by pressure in the variation of excitation functions has been brought out by the examination of the experimental intensities in relation to the mean electron energy found by probe method.

14. Role of the Method of Numerical Integration in the Band Intensity Theories.

N. R. **Tawde** *and* B. B. **Laud**, Bombay.

Conflicting evidences are coming to light regarding the applicability of the different theories of transition probabilities to band spectra. In the case of N_2 (second positive) system, Bates has shown fair agreement with Tawde's experimental values by the method of numerical integration using directly Morse's potential energy function. Nicolls adopting the same method derives values for the system not by directly using Morse's function, but by distorting the Hermitean polynomial to fit the Morse curve. Pearse and Gaydon and Pillows have by a similar process as that of Nicolls computed theoretical data for some molecules and found fair agreement of it with experiment. Applying the method to C_2 (Swan) we have failed to find the results confirming to our recent observations of intensities. This behaviour of the method of numerical integration is discussed in this paper.

15. Apparent Splitting of 5460 Line of Mercury.

N. R. **Tawde** *and* P. V. **Chandratreya**, Bombay.

It has been reported in an earlier paper that some lines of mercury undergo splitting as the mercury lamp attains stability after it is switched on. Probable causes were assigned for this. To analyse this effect, further investigations have been carried on by observing the fine structure of the green 5460 line. Four components of the line are identified and only one of them has been found to split. Asymmetry of the splitting reported to be present is due to the above cause. The apparent splitting and its magnitude have been interpreted in terms of the self-reversal and Doppler broadening.

16. Joshi Effect In Fluorescent Tubes.

A. P. **Saxena** *and* S. V. **Kelkar**, Indore.

'Diallist' (*Wireless World*, March 1950) reported that a few percentage of fluorescent tubes generate R. F. radiations and devastatingly interfere with Radio and Television reception. A system of suppression was therefore employed in the recent Exhibition at Olympia. Studies in Joshi Effect are associated with the generation of H. F. oscillations, and the coatings of the ozonizer walls from inside by different substance has a marked influence on the production; hence it was of interest to extend the studies of Joshi Effect to fluorescent tubes.

Fluorescent tubes of various sizes and colours (Day light, Blue, Green and Red) were employed for the studies of the Joshi Effect. The discharge current was rectified with the help of Germanium Crystal 1N34 (Sylvania) which has been reported to have uniform rectification characteristic from 0 to 150 megacycles. The source of irradiation was a mercury vapour lamp with Viterosil envelope. Since these tubes are coated by fluorescent salts from inside, white light could not be used for obvious reasons.

The fluorescent tubes employed in these investigations were directly connected to an A.C. potential source without the use of a choke and a starter. A higher potential was necessary to initiate the discharge but it could be maintained at a low voltage. In the neighbourhood of the maintained discharge some of the tubes showed Joshi Effect to a maximum of about 16% which fell sharply to zero as the exciting potential was gradually raised.

The sharp decrease in %Δi as the exciting potential is increased appears analogous to the production of the Joshi Effect in D.C. excited tubes with metallic electrodes (Proc. of Indian Sc. Cong, 1949, A_{32} A_{35} *Raman Rao.*)

One is, therefore, tempted to suggest if the nature of oscillations met with in the study of fluorescent tubes is similar to ozonizer discharge pulses.

17. The Joshi Effect over the Range of the Falling V-i Characteristic.

H. J. ARNIKAR, Banaras.

A systematic study of the L.F. ozonizer discharge through air and H_2 over the pressure range of 1-20 mm. Hg, showed that the $V=i$ characteristic has a negative slope over a sharply defined potential range $V_1=V_2$, the characteristic being positive outside this range on either side. The ozonizer employed was an all-glass type with a total electrode surface of 1300 sq. cm. As the potential (V) was steadily raised above the threshold minimum (V_m), the current in dark (i_D) increased at first to maximum (i_{D_1}) at V_1 and then started falling to a minimum (i_{D_2}) at V_2 after which there was a continuous rise. The same was also true of i_L the current under irradiation by light from a 200-watt bulb, and hence also for the net Joshi effect ($-\Delta i$). *Mean gradients* (K) of the negative segment of the $V-i_D$, $V-i_L$ and $V-(-\Delta i)$ characteristics are given by: $K_{1D}=(i_{D_1}-i_{D_2})/(V_2-V_1)$; $K_{1L}=(i_{L_1}-i_{L_2})/(V_2-V_1)$ and $K(-\Delta i)=(-\Delta i_1)-(-\Delta i_2)/(V_2-V_1)$. Results showed that $K_{1D}>K>(-\Delta_1)K_{iL}$. For instance, these values in H_2 at 5.5 mm. Hg pressure were:

		i_D	i_L	Δi
V_1 :	0.53 kV	570	360	-210
V_2 :	0.74 kV	420	312	-108
	K	-710	-230	-490

Through a negative characteristic is well known in the case of an arc, its occurrence in the ozonizer discharge has not been reported earlier. Francis attributes the negative characteristic of discharges in commercial lighting tubes to an increase in 'electron density faster than the current, 'electron velocity' being supposed to be constant. These assumptions are not mutually consistent. Pohl's view that the falling characteristic arises as a secondary temperature effect in systems with a positive temperature coefficient of conductivity, though permissible for electrolytes, cannot apply for a gas discharge. Joshi showed that the discharge current (in dark) consists of H.F. and L.F. components besides the supply frequency, and that under light the H. F.'s are preferentially suppressed. The present finding that $K_{1D}>K(-\Delta i)>K_{1L}$ implies that $di_D/dV>di_L/dV$. Hence, in the light of Joshi's theory, the falling characteristic would appear to be associated mainly with the H.F. component of the discharge current. Potential variation of the wave form of the discharge current in dark and under light, as seen on the C.R.O. over the potential range V_1-V_2, fully corroborate this view.

18. The 'Corona Pressure' Effect in Air. Action of Repeated Discharges.

H. J. ARNIKAR, Banaras.

An instantaneous and reversible pressure rise (Δp) occurring in a gas with the application of a potential, high enough to produce a discharge in it, is referred to as the 'corona pressure'. This sudden pressure rise is followed by a slower rise: this latter is known to be a purely thermal effect of the discharge. First noticed by Farwell in coronae from wires, the phenomenon has since then been studied by others, notably Kunz, Tyndall and Joshi and their collaborators. In the present work, the study was extended to air subjected to low frequency discharge in a large Siemens' ozonizer of total electrode surface of 1300 sq. cm. with an arrangement for the cooling of both the H.T. and L.T. electrodes by iced-water at a constant temperature. The corona pressure effect (Δp) was measured by extrapolating the time-pressure curve to the instantaneous value. Δp was found to diminish progressively on repeating the discharge at a constant potential at regular intervals in succession. Thus, at an initial pressure of 462 mm. Hg and exciting potential of 9.25 kV(r.m.s., 500 c/s), the Δp values for the I, II, and III consecutive discharges were 3, 2, and 0.5 mm. Hg, respectively. In the IV discharge, Δp was reduced to 0.1 mm. Hg. Such a progressive suppression of Δp in consecutive discharges, *ceteris paribus*, was observed over a wide range of initial pressure (260-500 mm. Hg) and applied potential ($8-10kV$). Prolonging the interval between successive discharges from 5 to 30 mts. or/and a slight variation of the potential did not alter the results. Admixture of a trace of fresh air, however, at once restored the Δp to the value found in the first discharge. These effects due to repeated discharges, not having been observed in hydrogen and nitrogen, appears to be associated with the formation of ozone. This is supported by the finding that Δp is immeasurably small in ozonized oxygen and in hydrogen contaminated with hydrogen sulphide. Results are discussed from the point of Tyndall's theory that $\Delta p = i/4\pi k$, where i is the discharge current per unit length of the electrode, and k the ionic mobility.

19. Role of Surface Contamination by Metallic Powders (Al and Zn) in the Production of Joshi Effect.

B. M. SHUKLA, P. K. TIKOO *and* K. N. KHARE, Banaras.

Earlier work on the production or/and enhancement of the phenomenon Δi in topler evacuated ozonizers, refers to surface contamination by inorganic salts. The significant results obtained thereof led to the present work with Al and Zn powders as 'wall contaminating' materials.

The ozonizers, containing one of the metallic powers in a separate attached bulb, were excited in the range 0.3kV—1.6kV (50~). Observations made, when powders had not come in contact with electrode surfaces, showed no ∇i even after prolonged 'ageing'. Later the tubes were shaken to contaminate the wall surface with the metallic dust and then tapped to remove extra particles. Results now obtained gave substantial i_D, Δi and % Δi. The tube with Zn-contamination, showed —54% ∇i near about V_m, which on sufficient 'ageing' increased to -93%.

A -100% Δi near about V_m decreasing with increasing kV, is observed in ozonizer with Al-contamination. Prolonged 'ageing', however, completely eliminates this Δi. Subsequent shakings and fresh contaminations give decreased—%Δi which subsequently vanish by 'ageing'. This remarkable elimination of Δi due to 'ageing, is akin to 'Photo-electric fatigue', so common with metallic surfaces.

The above remarkable production of Δi by mere presence of Al and Zn powders, further suggested the essentially 'surface origin' of *Joshi Effect* and it seems that the metallic particles at the electrode surface act as 'active centres' for photo-electron emission as a consequence of a favourable formation of the 'activated adsorption like layer'.

20. Surface Sensitivity of Joshi Effect in Water Vapour.

N. A. RAMAIAH *and* K. PARVATI DEVI, Banaras.

Surface dependence of the *effect* Δi was investigated in blank and KCl-coated ozonizers filled with water vapour (11.5 mm. Hg, 28°C). They were excited by $0.5-2$kV (50~) and the current was measured by a galvanometer connected to a diode or a vacuo-junction. Required portions of the ozonizers were exposed to constant intensity of radiation from a 200-watt bulb. The *effect* varied sensibly linearly with either blank or KCl-coated surface. Thus *e.g.*, at 0.66kV, % Δi was 2.2, and 30.0 with 5 and 62 sq. cms. ozonizer surface (blank) irradiated. A change in the slope of the lines gave a measure of the influence on Δi of KCl and applied potential. Deviation from this linearity was occasioned only by alteration of the nature of the surface, suggesting the marked significance of the electrode surface in causing Δi

21. Effect of the Nature of the Glass of the Ozonizer in the Production of Joshi Effect.

A. P. Saxena, Indore.

Since Joshi Effect is fundamentally of surface origin or more precisely 'solid (electrode)—gas interface'(Joshi, *Current Science*,1945, 14, 35), it was of interest to investigate the effect with the nature of glass of the ozonizer, other parameters remaining identical.

Two identical ozonizers, one of hard Indian glass and the other of Pyrex glass tubing (manufactured by Biswas & Co., Calcutta) were filled exactly similarly with pure iodine in contact with solid phase.

The ozonisers were identically excited and the detector used was Galvanometer (Gambrell) actuated by Germanium Crystal diode 1N34.

Hard Indian glass ozonizer showed an instantaneous – ve effect which increased to a maximum of 30% with a few hours' ageing and fell to 10% with prolonged ageing. The current under dark also decreased appreciably under prolonged ageing. The threshold potential V_m decreased by 15% with ageing. No +ve effect was observed.

Under identical conditions Pyrex glass ozonizer did not show any effect with a few hours' ageing. Prolonged ageing showed –ve effect to a maximum of 14% which tended to increase with ageing. The threshold potential V_m was practicaly the same and decreased by 5% with ageing. Large +ve effect was observed initially below V_m which decreased with ageing.

In general, irradiation had a stabilising action on the fluctuating current under dark.

All the observations can be explained on the phenomenon of adsorption of gases on solid and the formation of 'Adsorbant-adsorbate' layer fundamental to the production and retention of Joshi Effect.

Experiments are under way with an identical Quartz Ozonizer.

22. Production of Negative Joshi Effect in Mercury Vapour Free Hydrogen in Ozonizer Discharge.

D. P. Jatar *and* G. M. Pandit, Banaras.

Siemens' type all glass ozonisers were filled with carefully purified hydrogen (obtained by electrolysis of $Ba(OH)_2$) in the pressure range 2 to 54 mm. Hg. The gas was freed from traces of mercury vapour by streaming it very slowly and repeatedly through traps cooled by liquid air and further by slow diffusion through tubes packed with gold and silver foils. Only negative effect $-\Delta i$ reaching a maximum of 71% current diminution was observed. At constant pressure a large increase of applied potential above the threshold decreased $-\Delta i$ markedly. The results also show that $-\Delta i$ cannot be associated with any role due to excited mercury atoms.

23. Influences of Temperature on the Joshi Effect in Oxygen at Different Gas Pressures.

S. R. MOHANTY, S. C. MOHANTY *and* Ch. B. N. NANDA, Banaras.

The Joshi effect Δi was observed in oxygen at different gas pressures (40-650 mm. Hg) p and excited over 1-9 k V(r.m.s.)of 50 cycles frequency as a function of temperature t varied from 20° to 120°C. The discharge current i increased with t. At low p, *e.g.* 48 mm. both the net *effect* Δi and the relative *effect* $\%\Delta i$ increased with t. Thus, at 3.47 kV, Δi increased from 1.06 at 20°C to 5.95 at 120°C, and $\%\Delta i$ from 16.0 to 31.4 over the same t range. At higher p both Δi and $\% \Delta i$ at first decreased with t and then increased. Thus *e.g.*, at 641 mm. and 7.21 kV, values for Δi at 20, 40, 60, 80, 100 and 120°C were respectively 1.47, 0.76, 0.80, 1.76, 3.19 and 4.60, and those for $\%\Delta i$ 12.0, 5.0, 4.7, 7.7, 12.5 and 14.5.

24. Comparative Studies of the Joshi Effect in Stationary and Flowing Oxygen.

S. R. MOHANTY, Ch. B. N. NANDA *and* S. C. MOHANTY, Banaras.

Comparative studies of the Joshi effect Δi were made in (*i*) stationary and (*ii*) flowing oxygen in a Siemens' tube excited by different potentials ((1-6 kV r.m.s.) V of 50 cycles frequency, at various gas pressures (25-100 mm. Hg) p. Rate of gas flow in (*ii*) was varied and regulated, and measured by means of a flow-meter. The pressure difference at the ozonizer ends was never$>$ 0.2 mm. Hg. The 'threshold potential' V_m varied linearly with p, and was independent of condition (*i*) or (*ii*). At constant V, Δi was greater for (*i*) than for (*ii*). Thus *e.g.*, at $pO_2=45$ mm and 3.47 kV, $\%\Delta i$ under (*i*)was 25.0 and under (*ii*) at rate of flow=127 cc. (N.T.P.) per minute, 16.5, pO_2 remaining the same, Δi at constant V decreased with the rate of flow. Thus with 31, 46, 87 and 127 cc. (N.T.P.) streamed through the ozonizer per minute, $\%\Delta i$ was respectively 20.1, 18.4, 17.7 and 16.5. This effect was more marked the lower the p.

25. Studies of Joshi Effect in Stationary and Flowing Gas Systems under Silent Discharge.

M. V. RAMANAMURTI, Banaras.

That the discharge current, i_{dark} and the *Joshi Effect*, Δi are more in (a) *stationary* than in (b) *flowing* gas systems, was already reported (Murti, Rao and Prabhakaram, Part III, *Phys. Sec. A.* 34, *p.* 28, 1951). Oscillographic studies *now* made, revealed significant changes in the current structure. At $V \geqslant V_m$, a number of transients corresponding to high frequency (h.f.) pulses appeared on the peaks of the otherwise pure sine wave of current (at $V < V_m$, in (a) systems. These h.f.'s are diminished, even by 100 % at V_m ($P_{N_2}=20$ mm. Hg). *simply* by keeping the gas flowing at a steady rate, analogous to light action to yield negative *Joshi Effect*, $-\Delta i$. This accounts for the observed less quantities of i_{dark} and $-\Delta i$ in (b) than those in (a) systems.

26. Hysteresis in the Potential Variation of Discharge Current and Joshi Effect in Nitrogen under Sleeve Excitation.

M. V. RAMANAMURTI *and* S. C. PADHI, Banaras.

Carefully purified nitrogen was excited at $pN_2=20$ and 30 mm. Hg by applied V(0-7kV) of 50~, in tubeswith i and 12 mm. diameters with external sleeve electrodes. Discharge current i and *Joshi Effect* Δi were studied with increasing and decreasing kV. The nonidentity of i and the associated Δi referred to as hysterisis, was like the negative *effect* $-\Delta i$; detectable at the threshold potential V_m, increased to maximum at $kV > V_m$ and decreased at larger kV. Within the operative conditions studied, hysterisis was +ve, *i.e.*, i_{dark} and Δi (due to a fixed V) were larger with decreasing than with increasing kV.

These results are explained in the light of the maintenance potential, V_m', being smaller than V_m and Joshi's general finding that i_{dark} and the associated Δi are proportional, within limits, to $(V—V_m)$.

27. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part I: Influence of Applied Potential, Gas Pressure, Gap Length and Nature of Electrode Material.

M. V. Ramanamurti *and* G. R. Somayajulu, Banaras.

Earlier studies on the above phenomenon, $\pm\Delta i$ referred chiefly to discharge tubes with at least one glass electrode. Appreciable Δi (as 90-95% current diminution under visible light) in nitrogen in full- and semi-ozonizers and tubes with external sleeve electrodes was reported (Part III, *Phys. Sec., A*. 50, p. 30, 1950; *Chem. Sec., A*. 22, p. 40, 1951). Investigations are *now* extended to metal-electrodes-immersed-in-gas systems. Carefully *purified* nitrogen obtained from thermal decomposition of ammonium nitrite, was excited in Geissler tubes by 50 c/s potentials V (0-12 kV). Gas pressures 5-120 mm. Hg and gap lengths 3-20 cm. were studied. The electrodes were of parallel platinum wires or circular discs of Zn or Al. Both $\pm\Delta i$ were observed over the entire range of gas pressures. A maximum Δi as 100% diminution was observed at V_m for all values of p. *The occurrence of* Δi *was confined only to the preonset region for the spark-over.* Oscillograms of the current structure revealed total or partial rectification; + or $-\Delta i$ corresponded to an increase or a diminution respectively of the intensity and number of the h.f. pulses, identifiable with corona burst pulses. Visual studies of the discharge indicated that the region wherefrom the spark passes over is a chance factor. No Δi was obtained at $V > V_s$, spark potential. Unpolished Al plates showed large Δi while polished ones disfavoured it. This was attributed to the changes in the work function of the electrode surface. These findings are accounted for in the light of corona discharge mechanism and Joshi's theory for Δi.

28. Studies of Joshi Effect in Nitrogen in Geissler Tubes. Part II: Rôle of Partial Irradiation.

M. V. Ramanamurti *and* G. R. Somayajulu, Banaras.

Observation for the first time, of the occurrence of large *Joshi Effect*, Δi, over widely varied operative conditions in nitrogen in Geissler tube discharges was reported. Joshi's theory for Δi emphasizes its electrode surface origin. Studies for Δi were, therefore, made irradiating the whole tube or partially either of the high tension (H.T.) and low tension (L.T.) electrodes, or the gap alone. Visual changes in the discharge and also on cathode ray oscillograph were recorded. Threshold potential, V_m in these tubes may be identified with breakdown potential, V_6. That Δi occurs only in the preonset region for spark-over is reported. This region can be divided into intermittent and stable regions like the corresponding ones in D.C. corona discharge. Maximum $-\Delta i$, as 100% current diminution was obtained in both stable and intermittent corona regions by exposing the whole tube or H.T. alone to external but visible light; irradiation of L.T. electrode showed less $-\Delta i$ in the stable corona region and a distinct $+\Delta i$, corresponding to +ve *Joshi Effect*, in the intermittent corona region. Illuminating the gap *alone* showed no Δi. These results while indicating the significant role of an earthed point (L.T) in the production of *Joshi Effect*, also suggest that the *Joshi Effect* is of electrode surface origin as contemplated in Joshi's theory for Δi.

29. Influence of Frequency of Exciting Potential on Joshi Effect in Nitrogen.

M. V. RAMANAMURTI, Banaras.

Occurrence of a large $-\Delta i$, 5-95 % current diminution over widely varied operative conditions *e.g.*, applied potential, V, gas pressure, temperature and wavelength and intensity of radiations employed, was already reported (Part III. *Phys. Sec. A.* 50, p. 30, 1950). Influence of frequency (f) of exciting V is now investigated. Nitrogen ($p=20$ mm. Hg) filled Siemens' ozonizers were excited by $\sim$V of $f=50$, 500, 900 and 1500 c/s. $-\Delta i$ was obtained at all frequencies; its numerical value and range of V favouring it, decreased with increased f. Thus *e.g.*, $-\%\Delta i$ at 0.88 kV was 89, 71, 60 and 49 for $f=50$, 500, 900 and 1500 c/s respectively.

Threshold potential V_m, like spark potential V_s remained unaltered when f varied from 50 to 1500 c/s.

30. Dependence of Joshi Effect on the Electronic Part of the Discharge Current.

N. A. RAMAIAH, Banaras.

Association of Δi with electronic part i_e of the discharge current i was investigated by elimination principle. i_e was suppressed by exposure of cylindrical discharge tubes excited by external sleeve electrodes (1.6 mm. apart), containing H_2O at 10.5 mm. to transverse magnetic field H of desired strength. Decrease of i_e was accompanied by a like change in the amplitude of h.f.s., in agreement with results of Bhide, Bhidey and Asolkar (*Proc. Ind. Sci. Cong. Phys. Sec.*, 1950). Negative Joshi effect was maximum in i and appreciably small in $i - i_e$. Thus at 1.66 kV $-\%\Delta i$ was 49 in total i_e and 3 in $i - i_e$ comparatively $+\Delta i$ was unaffected by H.

31. Production of Joshi Effect in I_2 Vapour under H. F. Excitation.

N. SUBRAHMANYAM, J. V. SARMA *and* G. M. APPARAO, Banaras.

Earlier studies on the occurrence of the above phenomenon Δi, in iodine vapour under H.F. excitation showed the existence of a threshold frequency f_m at which, the discharge emitted a faint and flickering glow, large conductivity and maximum $\%\Delta i$. The present investigations with improved experimental technique, *viz.*, the measurement of R. F. voltage fed to the tube, measured by a vacuum tube voltmeter, initially calibrated with 50 cycles potentials, point to the fact, that the magnitude of $\%\ \Delta i$ depends chiefly on the R. F. exciting voltage rather than the frequency. Thus *e.g.*, at 2.95, 3.2, and 7.75 Mc. the $\%\Delta i$ was 66.6 (47.1 V), 58.2 (29.5 V), and 25.6 (13.5 V) respectively.

Oscillographic studies of the discharge current at different exciting frequencies, showed that at potentials corresponding to maximum conductivity and $\%\ \Delta i$, the wave was highly unresolved in dark, irradiation diminished markedly its amplitude and locking up of the trace was possible. This was observed at all exciting frequencies in the range studied, *viz.*, 1—10 Mc.

32. Investigation of Joshi Effect in a Geissler Tube under D. C. Excitation.

B. R. MARATHE *and* R. J. GALAGALI, Banaras.

D. C. potentials obtained from a H.T. unit (a diode-rectifier and a smoothing unit) were applied to a neon Geissler tube and it was found that the current was large and unaffected by light. A resistance in series with the circuit reduced the current but no effect was observed.

When only one terminal of the H.T. unit was connected to the discharge tube and the other terminal of the tube was earthed through a current detector, the discharge near V_m, was completely suppressed by light*. The effect was observed even when a small portion near the cathode was exposed to light. No effect was observed when the anode and / or a portion near the anode alone, was exposed to light.

When potentials from a dry battery set were applied to the Geissler tube, no effect was observed. Similar results were obtained with a hydrogen Geissler tube.

33. Occurrence of Irreversible Joshi Effect in Hydrogen.

K. S. VISWANATHAN, G. PATRA *and* A. K. HOTA, Banaras.

As in nitrogen and chlorine, the irreversible Joshi-Effect now observed also in hydrogen is transient in nature and is obtained only within the hysteresis range of the current below V_m. The negative Joshi-Effect $(-\Delta i)$ is shown by the system from potentials below V_m to potentials above V_m. No positive effect $(+\Delta i)$ is observed at any of the potentials studied. The negative effect $(-\Delta i)$ is maximum at V_m and as large as 86%. But the irreversible nature of the photocurrent is confined only to potentials below V_m. In this region, i_L can be restored to i_D only after raising the potential to a little above V_m and then bringing it down to required value. As in nitrogen, lowering the temperature favours the production of the Joshi-Effect over an extended range of potentials and pressures; the irreversible effect is destroyed and never obtained when the temperature is raised above a limiting value which depends upon the pressure of the gas. The observation of the irreversible Effect in the hysteresis loop below V_m and its destruction by high temperature is in accord with Joshi's theory of the Effect, *viz.*, that an "adsorption-like layer of low work function" is the primary seat of the phenomenon.

34. Studies of Negative Joshi Effect in Hydrogen Discharge with Metallic Electrodes: Influence of the Gas Pressure and Applied Potential.

D. P. JATAR *and* G. M. PANDIT, Banaras

Review of the literature having shown that data on above phenomena $(-\Delta i)$ are almost confined to Siemens' ozonizer type or with dielectric electrode discharges, a detailed investigation was made using Crookes' type tubes excited by H.T. transformers fed on the primary by low frequency A.C. Employing *e.g.*, aluminium electrodes 3.7 cm. apart, connected to potentials varied in the range 0.6 to 2.8 kV. *Joshi effect* corresponding to practically 100% current decrease, also revealed by the instantaneous and reversible suppression of the H.F. pulses as viewed with a cathode ray oscillograph with but visible light was observed. Increasing the gas pressure at constant kV increased the effect at less than 18 mm. Hg, above which it decreased rapidly with pressure. The effect was found greatly disfavoured with copper electrodes which caused copious sputtering under discharge.

Ageing under the discharge reduced $-\Delta i$ at low but not at large pressures.

(*The current oscillogram consisted of random pulses in only one direction. These disappeared under light.)

35. Study of Joshi Effect in H_2 in a Siemens' Ozoniser Discharge: Influence of Splitting the L.T. Electrodes in (a) Earthed and (b) Floating Segments.

D. P. JADAR *and* G. M. PANDIT, Banaras.

The inner tube of the ozonizer, with H_2 at 49 mm. Hg. in the annular space, was filled with an electrolyte solution and connected directly to the H.T. electrode of the transformer secondaries (the other being earthed). The outer tube was wound-over solenoid like by tight fitting copper wire in 4 separate segments insulated from each other, any of which could either be (a) earthed or (b) left floating. Each of the segments called A, B, C, D, represented approximately equal area; A was near the internal seal at the top of the ozonizer and D at the bottom. In the first series of experiments each of the segments A, B, C, D was earthed through a detector when the whole system was in dark (i_D) and when *that earthed segment only* was irradiated.

The V-i characteristic in dark in A, B, C, D, showed an initial steep rise followed by a slower change and rapid increase. The intermediate section becomes more pronounced for D; in A it is represented by a remarkable 'negative characteristic', a current decrease with increased voltage. Relatively $-\Delta i$ is maximum in D.

In the second series, observations were made for i observed in D, and when the segment A was irradiated, as follows:

1) A, B, C floating, $\dfrac{100\Delta i}{i} = -\ \%\Delta i = 20$ (max).

2) A, B, floating, C earthed $-\ \%\Delta i = 38$ (max).

3) A floating, B and C earthed $-\ \%\Delta i = 57$ (max).

4) All A, B, C earthed $-\ \%\Delta i = 92$ (max).

In the above cases i_D decreases as $4<3<2<1$. $-\ \%\Delta i$ was 58 when A was earthed and B, C left floating, there was no 'negative characteristic', except in No. 4.

The decreased i from 1 to 4 is attributed to a by-pass action; the corresponding marked increase in $-\ \%\Delta i$ is due to the result that the net $-\ \Delta i$ increased from 1 to 4.

Studies of Δi when the whole ozonizer was excited with A.C. frequencies of 50, 60, 100 and 500~ showed that except in the last case the 'negative characteristic was observed. In the above frequency range the effect decreased with an increase in the supply frequency. At any voltage the current was larger the higher the frequency.

36. Joshi Effect in H_2 Using a Discharge Tube with External Plane Parallel Electrodes: Variation of the Diameter of the Electrodes and Their Distance from the Tube.

B. R. MARATHE *and* R. J. GALAGALI, Banaras.

Joshi effect was studied in a discharge tube with plane parallel metal electrodes placed externally in contact with the flat ends of the tube. The diameter of the electrodes was varied and it was found that a decrease in diameter caused a decrease in the discharge current and an increase in the effect. The threshold potential, V_m, was almost constant for all the diameters used.

Keeping the earthed (L.T.) electrode in contact with the tube, the other (H.T.) electrode was moved away from the tube, when the discharge current as well as *Joshi effect* were reduced. V_m increased with the distance of the electrode from the tube. Results were similar when both the electrodes were kept away from the tube. When the L.T. electrode alone was placed away from the tube, the current was less but the V_m and the effect were unaffected.

37. Studies of Joshi Effect in a Discharge Tube with Plane Parallel Electrodes Placed Externally in Contact with the Tube: (a) Pressure Variation of H_2 (b) Length and Diameter Variation of the Tube.

B. R. MARATHE *and* NAGESH R. KULKARNI, Banaras.

Studies of *Joshi Effect* in H_2 were carried out in a discharge tube with plane parallel electrodes *placed outside the tube*, in a pressure range of 2 to 325 mm.Hg. The current and the effect increased with pressure. An almost complete suppression of the current was obtained on irradiation, at higher pressures (in the range 55 to 325 mm. Hg) at the threshold potential V_m. A small positive effect was just detected at lower pressures. The plot of V_m *vs.* p, was approximately linear with a slight curvature towards the p-axis at higher pressures.

With the above type of discharge tube, a detailed investigation was carried out to find the influence of the length and the diameter of the tube on *Joshi Effect* in H_2. The negative *Joshi Effect* increased with an increase in the length of the discharge tube. V_m was directly proportional to the length of the discharge tube when the length was small; at higher values of the length, V_m was practically constant.

Keeping the length of the tube constant a variation in the diameter revealed that the current as well as the effect increased with the diameter of the tube. In general, the effect was negative near V_m and positive at higher potentials. V_m increased with a decrease in the diameter of the tube, reached a maximum and decreased lightly with a further decrease in the diameter.

38. Influence of a Strong Magnetic Field (H) on the Behaviour of Siemens' Ozonizer Giving Joshi Effect under Electric Discharge.

N. A. RAMAIAH *and* P. V. RATNAM, Banaras.

When a Siemens' type ozonizer containing H_2O vapour and showing large Δi, was exposed in its unexcited condition to large H and tested at $H=0$, the following hitherto unreported effects were observed: threshold potential V_m increased sensibly; conductivity i due to a given potential V or $V-V_m$ appreciably large; and what was more no Δi could be detected. Thus V_m was 0.55 and 0.83 kV, i and the corresponding Δi were 10 and 70% at 0.66 kV and 164 and 0% at 1.05 kV, before and after exposure of the discharge tube to $H=420$ gauss. The system behaved altogether *new*. The above effects were marked in a KCl-coated ozonizer. Some time appeared necessary for the restoration of the initial condition. The entire trend of the above findings could be repeated for 14 times using the same discharge tube, which was latter unaffected by even $H>>1300$ gauss. Data were less often irreproducible when the tube was placed unsymmetrically or rotated in H.

39. Magnetic Analogue of Joshi-Effect.

M. R. BHIDAY, V. G. BHIDE, *and* G. V. ASOLKAR, Nagpur.

It is found that the effect of the magnetic field $(\Delta i)_H$ is very much similar to that of light $(\Delta i)_L$ on the ozonizer discharge current. The potential variation of $(\Delta i)_H$ is similar to that of $(\Delta i)_L$ Reversible positive effect $+(\Delta i)_{H,L}$ occurs in both at potentials just below V_m. At or near V_m this positive effect due to a magnetic field changes over sign to $(-\Delta i)_H$ similar to the Joshi-Effect $+(\Delta i)_L \rightarrow -(\Delta i)_L$. With further increase of potential, —$(\Delta i)_H$ rises to a peak value and then decreases gradually. The range of potentials for the occurrence of —$(\Delta i)_H$ is fairly wide, while that of light is restricted to a narrow range above V_m.

The results are explained on a possible analogy of the mechanism of counter discharge with that in an ozonizer. In a counter, the Townsend avalanches generate a pulse which rises sharply due to rapid electron collection and declines slowly due to slow-moving positive ions. This pulse as seen on the C.R.O. shows an unmistakable resemblance with the *h.f.* pulse observed in an ozonizer discharge. As in the counter, the discharge current through an ozonizer is equal to Q/t_a+t_m.

The motion of electrons under transvere magnetic fields is cycloidal. This causes an increase in Q and also t_m. The magnetic field is found to suppress the spurious pulses. The effect is thus three-fold, (*i*) to increase Q and hence the normal pulse height tending to increase *i*, (ii) to increase t_m, tending to decrease *i* and (iii) to decrease Q by the suppression of satellites. The net effect $\pm(\Delta i)_H$ is the resultant of these opposite tendencies.

40. Studies of Joshi Effect under X-ray Irradiation.

B. R. MARATHE *and* R. J. GALAGALI, Banaras.

Investigations of *Joshi Effect* under X-ray irradiation were carried out with a neon Geissler tube and two ozonizers containing Cl_2 and H_2 separately. No effect was obtained with the neon Geissler under X-rays, although the discharge was completely suppressed under visible light.

The ozonizers showed about 50-60% effect under visible light and about 15-20% effect under X-rays. The ionizing action of the X-rays in the gas appears to be responsible for the reduction in the effect.

41. Joshi-Effect with X-rays in Solid Vapour Systems.

(*Se-Se*; *Zn-Zn*; *Te-Te*).

M. R. BHIDAY, Nagpur.

The basic role of the applied potential, intensity and hardness of X-rays in the production of Joshi-Effect is studied. The intensity and hardness of X-rays are varied by adjusting the filament current and anode voltage respectively. This gives an intensity variation independent of hardness.

The potential-variation shows a reversible $(+\Delta i)$ just below *Vm*, reverting to $(-\Delta i)$ at and above *Vm*. Increasing the intensity from 0.5 mA to 2.0 mA, causes an increase in $(-\%\Delta i)$ rapidly. This reaches a peak value at intensities in the neighbourhood of 2.5 mA and with further increase of I, $(-\%\Delta i)$ decreases. Increase of hardness upto 20.1 kilovolts causes at first a linear rise of $(-\%\Delta i)$ followed by a much slower rise in the effect with further increase of hardness upto 26.3 kilovolts.

The ozonizer discharge is shown to be analogous to the counter discharge. The h.f. pulses occurring in such discharges are influenced markedly by changes in the ionic concentrations in the gap. Townsend avalanches generate a pulse and leave behind a space-charge (A). Under irradiation this initial space charge is augmented by an additional space charge (B). This results, according to Wilkinson, in the diminution of α. and hence the consequential decrease of pulse height and discharge current. The effect $(-\Delta i)$ depends,on the concentration of (B).

42. Joshi-Effect in Nitrogen under X-rays [Semi-Ozonizer].

V. G. BHIDAY, Nagpur.

Wire-in-cylinder type discharge tube approximating to a Geiger Counter has been employed for the first time to study Joshi Effect with X-rays in nitrogen. The results observed with this type of discharge tube are essentially similar to those observed with a full ozonizer.

At potentials well below the threshold potential, the discharge current is negligible. The current structure consists of a 50 cycle a.c. trace without any appreciable distortion. Irradiation of the discharge tube with intense X-rays does not produce any change in the discharge characteristics *viz.* the discharge current and its structure. With the progressive increase of the exciting potential, there is a random production of h.f. pulses whose frequency increases as V_m is approached. At and above V_m, a regular unbroken succession of current pulses are observed on the oscillograph. In this range of potentials just below V_m, the irradiation produces an instantaneous and reversible increase of discharge current $(+\Delta i)$. This $(+\%\Delta i)$ increases initially with the applied potential and subsequently decreases and finally inverts to $(-\%\Delta i)$ at V_m. Thus, positive Joshi effect invariably occurs in the potential range just below V_m *i.e.* in the non-self maintained discharge. In the self-maintained discharge *i.e.* above V_m, irradiation produces a decrease in current and also a sharp reduction in the pulse height. The $(-\%\Delta i)$ is maximum at V_m; and decreases with the increase in $(V-V_m)$. Thus, $(-\%\Delta i)$ was 31.1 at 0.75 kV (Threshold potential), it decreased gradually to 10.8 at 2.25 kV.

With the progressive increase of the intensity of the X-ray beam $(-\%\Delta i)$ at a given exciting potential increases initially rapidly (0.5 to 1.5 mA); reaches a maximum (1.5 to 2.0 mA) and finally decreases slowly (2.0 to 6.0 mA). Thus, at exciting potential 1.20 kV $(-\%\Delta i)$ is 15.0 at 0.5 mA; 22.8 at 2.0 mA and 13.8 at 6.0 mA. The optimum intensity for the production of maximum Joshi Effect lies in the region (1.5 to 2.0 mA) and depends upon the hardness of the X-ray beam and is relatively unaffected by changes in exciting potential. The variation of $(-\%\Delta i)$ with the hardness of the X-ray beam, however, shows a linear rise.

48. The Joshi Effect in the Positive Ion Current in Air under X-rays.

H. J. ARNIKAR, Banaras.

Air at a low pressure (0.1 – 1 mm. Hg) was subjected to an electric discharge in a glass tube with parallel disc metal electrodes excited by half-wave kenetron rectified potentials in the range 1.9–3kV. A hole in the centre of the cathode (C) permitted a part of the positive ion current to be drawn beyond this to be collected by an additional electrode (C′), both C and C′ being earthed respectively through a (*a*) D.C. microammeter and (*b*) reflection galvanometer. *a* indicated the total tube current; *b* the part of the positive ion current collected by C′. The tube was evacuated by two Hg vapour diffusion pumps serially connected and backed by a Cenco Hyvac. Gas pressure was read by a Macleod gauge. X-rays were obtained from a Coolidge tube fixed vertically above the‘ discharge tube and provided with a lead shutter. Galvanometer reading of the discharge current in ‘dark’ (i_D) was read after the X-ray unit was switched on and the controls adjusted. To read the current under irradiation by X-rays (i_L) only the lead shutter had to be pulled out. Thus, both i_D and i_L were measured without disturbing the electrical load. With a fine leak to the tube, so arranged that the striation width of the positive column nearly halved itself in about 40 mt.'s time, the following were observed. (1) i_D fell slowly with time. In a particular experiment at 2.2 *kV*, i_D fell from 250 to 248 (mm. deflection) in 5 mts. (2) On irradiation, i_L fell by 10 divisions instantaneously $(-\Delta i)$, and continued thereafter to fall as in (1). (3) On screening of the X-rays, $-\Delta i$ was not annulled, but i_D continued to fall at the same rate as in (1). (2) and (3) imply the production of an *irreversible negative* Joshi Effect of about 4% in the positive ion current in a flowing system of air, due to irradiation by X-rays. The corresponding change in current structure as viewed on the screen of a C.R.O. consisted in a marked diminution in the rate of production of H. F. pulses on exposure to X-rays. In the experiment cited, about 2 pulses appeared per sec. in 'dark'; on irradiation the number fell to less than one per minute. The recent findings of Andrè Canac *et al* agree with this.

44. Theories of Light Effect.

MRINMAYEE GHOSH *and* ARUN KUMAR SAHA, Calcutta.

The theories proposed so far to explain the "Light Effect" in an ozonizer tube have been examined critically. It is concluded that of all the theories the one proposed by Deb and Ghosh offers a simple and consistent explanation of the light effect phenomena. The so-called "Positive Light Effect " which had not been originally discussed by Deb and Ghosh is explained in the paper on the basis of their theory. Attention is invited to the fact that many of the theories proposed subsequent to that of Deb and Ghosh, assume, as first postulated by Deb and Ghosh, the production of an adsorbed layer of molecules of the containing gas on the glass surfaces enclosing the discharge space. According to the theory the origin of the effect is to be traced to the action of light on the surface charges produced (under discharge condition) on the adsorbed molecular layer.

To test the correctness of the above theory, the ozonizer was excited by sharp voltage pulses as originally done by Deb and Ghosh. It was observed that the lengths of the exciting pulses (which are increased under discharge condition) as also the lengths of the h.f. discharge current pulses (in the opposite direction) are both diminished in amplitude when the ozonizer tube is flooded with light.

The results are incomplete agreement with the theory proposed by Deb and Ghosh.

45. On the Dynamo Theory of Geomagnetic Field Variations.

S. K. CHAKRABARTY *and* R. PRATAP.

The Dynamo theory developed by Stewart, Schuster and Chapman in order to explain the geomagnetic field variations no doubt give qualitative explanations for the observed variations but differ appreciably in details. In the present paper, the analysis of Chapman has been extended and the Dynamo equations have been solved without approximations which are difficult to justify. The solution of the Dynamo equation has been given in the most general form which can be used for any given 'Ionospheric conductivity' and 'atmospheric oscillations'. The results obtained have been compared with that of Chapman which shows the effect introduced in the final result by the approximation used by Chapman. The results have been used also to calculate the diurnal variations in H and V and the results have been compared with the observed data. The results show that with a reasonable assumption for the conductivity and the atmospheric oscillations, the Dynamo theory can very well explain the observed facts.

46. Dielectric Properties of Salt Solutions in the Range of Ultra-High Frequencies (230-330 Mc/s).

R. SANKARAN *and* S. R. KHASTGIR, Banaras.

Working with an Acorn tube oscillator and inducing ultra-high frequency oscillations (230-330 Mc/s) into a Lecher-wire system terminated at the input-end by a small parallel-plate condenser enclosed in a glass vessel and short circuited at the far end by a sliding bridge, the dielectric properties of (1) sodium chloride, (2) potassium chloride, (3) magnesium chloride, (4) copper sulphate solution, for varying concentrations (0-3%) were studied by adjusting the resonance lengths with air and with the particular solution in the terminal condenser.

The dielectric constant was found to attain a saturation value at a particular concentration value (0.4-0.6%).

Absorption- concentration curves for each of the four salt solutions were studied in detail by drawing the space resonance curves with different concentrations of the salt solution inside the terminal condenser of the Lecher-wire system. Relaxation times obtained from the absorption measurements agreed fairly well with the values calculated from Falkenhagen's expression. The values of the product of the wavelength corresponding to maximum absorption and the normality of the sodium chloride solution expressed in gram equivalents per litre has been found to be constant. This constant agreed fairly well with that of Forman and Crisps and Chatterjee and Srikantan, and also with that of Satyanarayana and Khastgir. With the values of relaxation time obtained from the absorption curves, Debye's dispersion, absorption and loss tangent curves have been drawn for certain concentrations of the solutions. The radius of the rotor calculated from Debye's formula on the basis of our determinations of relaxation time was found to agree with the value of the radius of ionic atmosphere as obtained by Falkenhagen.

47. Atmospherics Recorder.

B. A. P. TANTRY *and* S. R. KHASTGIR, Banaras.

For studying the wave-forms of atmospherics received at Banaras, the voltage variations across a condenser in a damped antenna have been amplified by a R-C coupled aperiodic amplifier constructed for the purpose. For the automatic photographic recording of the waveforms on the oscillographic screen, (i) a cathode ray beam restoring unit and (ii) a cathode ray beam maintenance unit have been designed and constructed. To compensate for the disturbing effect of the undesirably large inductive action of the A/C power mains on the aerial provision has been made for applying a voltage with suitable phase and amplitude. A transient generator has also been constructed for test purposes.

48. Study of the Polarization of the Downcoming Wireless Waves of Medium Wavelengths.

R. SATYANARAYANA, K. RAMADAS, *and* S. R. KHASTGIR, Banaras.

The polarisation characteristics of the downcoming waves of medium wavelengths from Delhi ($\lambda = 338.6$ metres), Amritsar ($\lambda = 400$ metres), Hyderabad ($\lambda = 411$ metres), Lucknow ($\lambda = 293.5$ metres) and Allahabad ($\lambda = 389.6$ metres) were studied in detail in the evening and early night hours following Ratcliffe & White's method. In the case of Lucknow and Allahabad, the ground waves were suppressed before obtaining the polarization patterns of the downcoming waves. The elliptic patterns on the oscillographic screen showed that only the *ordinary* waves with a *left-hand* sense of rotation were received, the extra-ordinary waves being absorbed. The ordinary wave was found to be, in general, elliptically polarized. There was evidence of linear and circular polarization as particular cases.

The ratio of the normal to the abnormal components and phase-dfference between them were both found to vary in a random manner. Usually the phase difference was less than $\frac{\pi}{2}$ and quite a number of times it was $\frac{\pi}{2}$. At times, the phase difference was found to lie between $\frac{\pi}{2}$ and π, and occasionally it was 0 and π, when the patterns were *linear*. On a number of occasions the circular polarization was observed showing that the normal and the abnormal components were equal in magnitude with a phase difference of $\frac{\pi}{2}$. The circular patterns were not associated with strong signals as had been found by Ratcliffe and White.

49. Absolute Neutron Flux from a Ra+Be Neutron Source.

N. K. SAHA, M. CHOUDHURY *and* L. KASTURI RANJAN, Delhi.

The β-activity of Mn^{56} produced by the capture of slow neutrons in Mn was made use of in the measurement of the total flux of a 100 milligram, Ra+Be neutron source. The relative reduction in activity of a large volume of a solution of $MnSO_4$ activated to saturation by the source with and without an absorbing layer of pure managanese powder surrounding it was measured by a specially designed immersion counter. The absolute activity of the absorber manganese powder was measured by a carefully calibrated end-window β-ray counter and corrected for geometry, back-scattering and self absorption of the β-rays. The total flux is given by $No = A/(1-R)$ where A = the absolute activity of the absorber manganese and R = the ratio of $MnSO_4$ activity activated with and without the Mn absorber. With our measured value of $(I—R) \sim 7.5\%$ and corrected $A \sim (3.6 \pm 0.2) 10^4$ for 240.1 gm of pure Mn, a value of $No \simeq 4.8 \times 10^6$ neutrons per gm per sec. is obtained. The result is compared with those of other workers and the advantages of the present method and its possible sources of errors are discussed.

50. Elastic Scattering of 32 Mev Protons from Gold.

S. N. GHOSHAL, Lucknow.

32 Mev protons from the linear accelerator of the University of California, Berkeley, were scattered from a thin (10 mg/cm²) gold target, and the elastically scattered protons were detected in Ilford C^2 photographic emulsion. The elastically scattered protons were distinguished from those scattered inelastically, by the absorption of the latter (which has lower energy) in a suitable copper absorber in front of the plates. Only protons passing through this absorber could reach the plates. Because of the fact that at higher proton—energies, the protons pass very close to the nucleus for relatively large angles of scattering, nuclear forces will begin to be appreciable on it. Hence a departure from the pure Coulomb scattering (Rutherford scattering) will set in at larger angles of scattering. The angles of scattering at which departure from Rutherford scattering may be expected to start will depend upon the nuclear radius, which is the range of nuclear forces. Hence a study of the scattering intensity at various angles of scattering would give us some idea about the nuclear radius.

The ratio of the observed scattering cross-section to the cross-section calculated from Rutherford scattering formula has been plotted against the angle of scattering. The result shows a definite departure from the classical Rutherford scattering at all angles except at very small angles. Comparison is made with theoretical results, with a nuclear radius $R = 1.3 \times 10^{-13} A^{\frac{1}{3}}$ cm. The theoretical calculations were carried out at M.I.T. under the guidance of Professor V. F. Weissokopf. The agreement between theory and experiment is only qualitative and not quantitative.

51. On the Directional Intensities of Cosmic Rays.

B. BHOWMICK, Delhi.

The paper deals with the directional intensities of cosmic rays with special reference to the East-West asymmetry. The East-West asymmetry for the hard component of cosmic rays has been measured with two telescopes of angular resolution of 10° in the vertical plane and 38° in the complementary plane. The asymmetry rises to a maximum of 13% at the Zenith angle $Z = 40°$ and falls at higher angles. The deviations of measured intensity from the $\text{Cos}^2 Z$ law has been plotted against zenith angle. This shows two prominancies in the Eastern azimuth and one in the West.

52. On the Energy Spectrum of the Shower Electrons in Cascade Showers.

DR. S. K. CHAKRABARTY, Sibpur.

With a view to compare the different theoretical results on the Cascade theory of Cosmic Ray Showers, the energy spectrum of the shower electrons have been derived from the analysis of Bhabha & Chakrabarty and that of Snyder. While the first analysis shows that $\beta P(E_1 t) \approx a \left(\frac{E}{\beta} \pm b\right)^{-s.}$ where a, b, s_0, depend on the energy of the primary and also the depth of the layer of formation, the results of Snyder give $\beta P(E_1 t) \approx A \left\{\log \frac{\beta}{E} + B\right\}$ where A and B are independent of E. The values of A, B are such that even at the maximum of the shower, there cannot be any particle of energy equal to or greater than the critical energy, however large the energy of the primary particle may be. Numerical values have been obtained for $P(E,t)$ for some different values of E, t, and it is suggested that if the shower spectrum is experimentally determined, particularly for the low energy region, it may decide from a comparison with the results of the present paper, the order of accuracy one can obtain by taking only the contribution of the first term in the series for $P(E, t)$ and $N(E, t)$. The reasons for obtaining anomalous results by Snyder has also been discussed.

53. A Note on the Apparent Disappearance of Radiation in the Theory of Expanding Universe.

NANDAGOPAL MAJUMDAR.

By studying the differential equation governing the rate of change of matter and that connecting the pressure and density of a universe filled with incoherent particles and radiations Tolman came to the conclusion that at certain stage the pressure of radiation would cease to build up—a result which tends to support de Sitter's conclusion that the theory of Expanding Universe is able to account for the apparent disappearance of radiation poured into interstellar space by stars.

In this paper it has been shown that by actual integration of the said equations, different conclusions can be arrived at under different initial conditions which also supports de Sitter's conclusion. In addition to this, if we assume that the Universe started to expand from the initial Einstein State (in this case initial radiation density is zero) we get the interesting conclusion that radiation starting from its initial zero value increases to a maximum in a tune which is of the order of the present age of the Universe and then asymptotically goes to zero.

54. Electron Diffraction of Some Crystals.

SUBODH KUMAR MAJUMDAR, Darjeeling.

The spacings of a number of cubical crystals have been determined by electron diffraction method and the values obtained compared with the standard values obtained by the X-ray diffraction method. The electron microscope used was the Borres–Ruska (Siemens) type. Metals like gold, copper and silver were shadowed on saponin membrane in high vacuum on a platinum-gold objective aperture of 0.3 mm. diameter. AgCl and AgBr were obtained by volatilising silver in presence of chlorine and bromine vapour respectively in high vacuum. The projective magnet piece was taken out while taking the diffraction photographs. High voltages of 55 and 70 KV were used in the various experiments. The wave-length of the electron beam was calculated from the theoretical formula and the spacings determined by the usual trial and error method. The values obtained from electron diffraction experiments agree generally with the standard values,

55. The Thermionic Work Function of Iron,

S. B. L. MATHUR, Lucknow.

A new method of determining thermionic work functions was developed at the University of Allahabad under the guidance of Sir K. S. Krishnan. The metal under investigation was taken in the form of a hollow cylinder provided with plugs at each end. One of the plugs was solid, while the other had a central hole about 1 mm. diameter. This cylinder was enclosed within, but insulated from, a graphite furnace tube which could be heated to various high temperatures by means of a heavy electric current from a transformer. The graphite tube and its fittings were kept in a water-cooled chamber which was kept evacuated by means of diffusion pumps both during degassing and during the measurements.

On being thus heated, the inner walls of the metal cylinder give off electrons which soon acquire equilibrium with the emitting walls and there is, consequently, an electron gas pressure developed within the cavity of the metallic cylinder—the magnitude of the pressure being dependent upon the temperature and the value of the thermionic work function of the metal. Owing to this pressure the electron gas effuses through the tiny hole at one end of the metal cylinder and such of the electrons as lie within the solid angle subtended at the effusion hole by the diaphragm of a Faraday Cylinder are caught by the Faraday Cylinder and are measured by a sensitive galvanometer.

If i_0 be the saturation current reaching the Faraday Cylinder at 0 voltage, T the absolute temperature of the emitting surface, it can be shown that

$$\log \frac{i_0}{T^2} = -\frac{\phi}{kT} \log_{10} e - \log_{10} A_0 \frac{Sr^2}{r^2+d^2},$$

where S is the area of the effusion hole, distant d, from the diaphragm of radius r, of the Faraday Cylinder and K is Boltzmann Constant.

If, therefore, the experimental values of log $\frac{i_0}{T^2}$ are plotted against the corresponding values of $\frac{1}{T}$ the slope of the curve will give ϕ, the work function, while, knowing ϕ, the value of A_0 can be calculated from the above equation.

In this way the thermionic work function of Iron was determined.

56. Microcisms at Washington, D. C.

J. N. Nanda. Cornell.

It is shown that the direction of the horizontal component in microcisms in general is the same as given by an analysis of three microcism records from horizontal pendulums placed at the corners of a triangle. The records were obtained during the period February—June 1951 at Washington D.C. The microcisms are not very pronounced during these months. The records show only a short portion in each record of five minutes total duration is capable of giving a consistent direction for a few cycles. In the major portion of the record the earth motion is complex. This is in part due to the low magnitude of the microcisms that are received, and in part due to the complex nature of the horizontal earth-motion. Many times the microcisms from the North-East and South-East were simultaneously received. Two horizontal motions at right angles to each other were compounded electronically and the direction of the resultant was recorded by the deflection of a mirror. On the same photographic recording paper, signals from the horizontal pendulums at the corners of a right-angled isosceles triangle and a vertical pendulum were recorded.

39th INDIAN SCIENCE CONGRESS, CALCUTTA.

(Section of Engineering & Metallurgy.)

President : Prof. J. N. Basu, M.I.E., M.A.E., Dr. Ing.

Abstracts.

1. *Alcohol—Petrol Blends as Fuels in I. C. Engine.*

B. S. Narayan Rao and M. S. Iyengar,
Hyderabad, Deccan.

The performance of a J. A. P. single cylinder Model 6, 5 H.P. Engine fitted with a modified water—cooled prony brake on alcohol—petrol blends of 20, 30, 40, 60 and and 80 per cent were studied at 12,000, 1600 and 1800 R.P.M. It was found that the B.H.P. at the minimum fuel consumption fell from pure petrol to 30 per cent. alcohol blend and thereafter did not alter with increase in alcohol content ; blend containing 30 per cent. alcohol gave no higher consumption than the basic petrol. Over 30 per cent. the reduced calorific value of the blend had a preponderent effect and the fuel consumption increased. The thermal efficiency percentage were calculated for different blends and it was found that a 30 per cent. blend had a thermal efficiency percentage of 34 which was higher than that for basic petrol.

The distillation curves obtained for different blends were not helpful in predicting the volatility of the fuel. The temperature of vapour lock were calculated for different blends from their corresponding vapour pressure and it was found that a 30 per cent. blend had the same vapour lock temperature as that for pure petrol.

2. "*Development of 'Flush' Heam Generator in India*".

Sri R. K. Mukherjee.

In view of the high rate of evaporation and smallness of the steam and water space in the drum of modern large water tube boilers, the prospect of pure "flash" boiler in the near future is promising.

A "flash" boiler as developed by the author consists of a bunch of straight parallel "flasher" tubes into which water in a finely divided state is sprayed at one end and steam which is instantaneously generated is collected at the other end through collecting headers. A portion of the length of the tubes is exposed to radiant heat of the furnace and the remainder to convection heat.

In order to reduce scale formation on the tube surface the author proposes to spray tomised water along the axis of the tube without contacting the tube surface. Instantaneous steam is generated by contact of water particles with the previously generated superheated steam, which is remaining in a violent state of turbulence due to rapidly intermittant bursts of spray. By such process, the solid impurities of water will remain in suspension and will be carried away with the steam, being prevented from depositing on the tube surface due to violent agitation of steam.

Research is being carried out with an experimental "flash" boiler, in which evaporation of 50 lbs. of steam per sq. ft. of heating surface per hour has been obtained. Natural circulation boilers usually evaporate 5 to 10 lbs. of steam per sq. ft. of heating surface per hour.

The "flash" boiler is small, compact and light weight and can be started from cold in a few minutes. Due to absence of any boiler shell, high pressure steam can be generated within small diameter tubes.

3. *On Testing, Standarisation and Blending of Foundry Sands.*

P. C. Ghosh, A. T. Pal and B. Chatterjee, Sibpur.

Some fundamental physical properties of three locally available sands and of their mixtures have been determined and correlated with their performances as both moulding and core sands in the actual manufacture of castings. The three sands were blended in varying proportions and suitably treated and by actual operations, optimum mixtures have been found out for some core sands for non-ferrous work and moulding sands for grey iron castings.

4. *Refrigeration in Market Milk Industry.*

Ramendra Nath Banerjee,

Calcutta

Market milk is understood to mean milk in the fluid state, sold to the consumer for direct consumption and is, thus, differentiated from milk which is destined for use in the manufacture of dairy produts.

Market milk industry, if organised properly under the Factory system of management with the modern scientific machineries, has a great future in India, where the number of dairy cattle is the largest in the world and the people are very much dairy minded.

The modern dairy system may be said to start within the life of the present generation, with various scientific inventions. But no invention has been more important to this industry than that of Mechanical Refrigeration. Refrigeration is universally at the Plant, for processing, for preservation and for distribution. In the post war period the application of Mechanical Refrigeration has even been more pronounced.

Milk is neither acidic nor alkaline and it has enough moisture and food supply. As such, it is an ideal medium for the growth of pathogenic bacteria. This can only be checked with proper control of temperature at different stages. Pasteurisation is a process in which milk is heated to a temperature of 145F, kept for half an hour at that temperature and then rapidly cooled down to 38F. It destroys almost all the disease producing bacteria for all practical purposes.

The present day market milk practice is to (1) produce the milk in the dairy farms in morning and evening and preserve it immediately in a milk-cooler below 50F, (2) collect both these supplies in the morning by a refrigerated van and bring them to the City plant, (3) store the milk in a refrigrated holding tank after testing for bacteria and butterfat content and standardising it for proper composition, (4) pasteurise it, bottle it and keep it in a cold storage and (5) deliver it to the consumers by van in crates packed with flake ice. In the farms the milk-cooler may be of (1) Storage tank type or (2) Dry box type. In estimating the size of the Refrigerating plant for this purpose, the important factors to be considered are (1) the quantity of milk to be cooled, (2) the temperature range through which it must be cooled, (3) the time available for cooling (4) the length of time the milk is to be held in storage and the length of time the refrigerating machine is to be operated. In the City Plant, after pasteurisation, the milk is cooled in one of these coolers, (1) Surface cooler, (2) Double tube or Tubular cooler and (3) Plate cooler. Regenerative system is employed where the in-coming cold raw milk on its way to the heater abstracts heat from the hot milk going to the cooler. The refrigeration system may either employ a Direct Expansion system or can use an intermediate medium of Brine or Sweet water. In the latter method, some amount of refrigeration might be stored up during the idle period, but the former method is more efficient and can use a higher back pressure. Both the initial and the operation costs are less in this case. Care should be taken to avoid freezing of milk at any stage. To supply flake ice for milk bottle crates, a Flake ice machine is employed where a thin film of ice is gradually frozen on to the outer surface of a rotary drum inside which cold brine is circulated. Ice is automatically peeled off as the drum turns and is deformed in shape while passing over a roller.

Before designing a Plant the following factors should be taken into consideration : (1) Product load should be analysed (2) what the future requirements are going to be and what provisions are to be made at present to take care of them (3) whether the various product cooling loads can be staggered during the day in order to avoid the high peak, (4) what the conditions of power contract are as far as demand charges are concerned as well as K. W. H. charges, (5) whether an Engineer would be available on duty 24 hours a day or not, (6) what system or type of milk handling equipment is to be installed ; refrigeration system to be employed has a direct bearing on it, (7) suitability and availability of city water for the condenser, (8) Initial and operation costs for different systems of refrigeration under the particular conditions have to be analysed carefully, taking into consideration the power supply, milk handling equipment, space required, insulation and refrigerating plant.

5. *Preliminaries of Design, Patent & Trade Mark in India.*

T. P. Datta, Calcutta.

The Industrialists and Manufacturers, Researchers and Artists, Scientists and Engineers are all vitally connected with the Industrial activity and development of our Nation and Country. Sir C. V. said "Indian must become leaders in the matter of Inventions and Discoveries". The products obtained by Research Scholars in Laboratories are therefore to be systemetically encouraged, carefully nursed and according to the Laws provided for that purpose by the Government, for example :

(1) A New *Design*, or the shape of an article can be protected before it is mad public by "Design Registration" under Section 43 of the Indian Patents and Designs Act, 1911, to obtain monopoly and protection, which can be effected in about a month's time.

(2) A *Patent* for an INVENTION for—

(i) a new process, method, or manner of making an article,

(ii) a new machine, apparatus or device, or even an old machine, apparatus or device used in a particular manner to avoid and solve difficulties hitherto experienced to obtain better results at lesser cost, and

(iii) a product, obtained according to above process or apparatus, which may be new, or if already known, when made according to above process, or apparatus, all these including the principle, if any involved in it, can be protected by applying for a Patent for this invention, before making it public, under Section 3 of the Indian Patents and Designs Act, 1911. This Patent may be obtained within a year, but when granted, the right will accrue from the date of application in the Patent Office.

(3) The good name of an article, or a product, on which the business or trade develops, or its association with a particular manufacturer when established, can be protected by a *Trade Mark*, either used, or properly selected before use, and registered under Section 14 of the Trade Marks Act, 1940.

Every Civilised Country has its own laws for the protection of Design, Patent and Trade Mark. In India, for Design Registration and Patent for Invention, application has to be filed in the Patent Office, Calcutta, the only office for this purpose under the Central Government for the whole of India. The Patent Office has a good Technical

Library for the Public-particularly for Inventors, Scientists and Engineers. For Trade Mark Registration, for the whole of India, application has to be filed either in the Head Office at Bombay, or in the Branch Office at Calcutta.

It is an absolute necessity as well as duty that Research Scholars and Artists Scientists and Engineers are well-acquainted with laws relating to Designs, Patents and Trade Marks of India and abroad, for the clarification of which references will bereceived with pleasure and dealt with cordially and expeditiously. All members, may, therefore, contact without hesitation or obligation.

6 *Electrodeposition of Cadmium from Cyanide-Free Baths : Cadmium Sulphamate Solutions.*

J. Mathur and T. L. Rama Char,

Bangalore.

The investigation was concerned with the deposition of Cadmium on steel from cadmium sulphamate solution, with a view to obviate the use of the poisonous and difficultly controlled cyanide bath in the electroplating industry. A detailed study was made on the effect of current density, electrolyte concentration, temperature, pH and addition agents on the nature of the deposit and the current efficiency. Satisfactory, bright and adherent deposits at cathode current efficiencies over 95 per cent. have been obtained from solutions having fair throwing power and low bath voltage at current densities upto 10 amp/dm^2. The effect of additions to the simple bath was tried and a combination of glue, thiourea and dextrin as addition agent was found to considerably improve the quality of the deposit and the conditions for eletrodeposition.

7 *Influence of Controlled Oxidation of Non-Caking Indian Coal on the Products of Low Temperature Carbonisation.*

M. S. Iyengar, B. S. Narayan Rao and R. Vaidyeswaran,

Hyderabad, Deccan.

Controlled oxidation of non-caking Tandur coal was carried out at 85°c. in a fluidized bed for 300 hours, and its effect on the percentage fixed carbon, volatile matter and Gray-King assay at 600°c. were studied. Mild oxidation tends to increase the yield of coke and gas and decrease the yield of tar. Further oxidation tends to increase the yield of tar correspondingly decreasing the yields of coke and gas.

8. *Sintering of Electrolytic Copper Powder Compacts.*

Asoka Gupta, Digboi

Sintering of electrolytic copper powder compacts fabricated at 25 tons pressure have been studied by observing the change in length in a dilatometer. Four particle sizes of the powder were taken and briquettes were formed with each of them.

The dilatometric curves show that at lower temperatures the increase in length is proportional to temperature. As the temperature increases the curves flatten out Above a "critical temperature" the length is found to decrease rapidly. The critical temperature varies with particle size being higher for smaller particle size of the powder. On repeatedly heating the same briquette in the dilatometer the linear relationship between length and temperature gradually extends. It is found that the shape of the curve approaches that for cast copper rods.

It has been found that sintering characteristics of the compacts depend upon the particle size of the powder. Experiments indicated that the rate of sintering of coarse copper compacts followed a hyperbolic law during the period (7 days) the specimens were heated.

9. *Temperature Sensitive Paints.*

S. M. Das Gupta, Delhi Polytechnic, Delhi.

Thermo-Colour or Temperature Indicating Paints were mainly developed in Germany, England, the U. S. A., during the last world war. They are useful in the study of heat processes, e.g. in testing the performance of gasoline engines, motors, heaters, electrical appliances, buzzbombs and the like. In this paper, two thermo colour or temperature sensitive paints, composed of double iodides of mercury and copper $Cu_2(HgI_4)$ and of silver and copper $Ag_2(HgI_4)$, have been prepared and studied. The paint made rom $Cuf_2(HgI_4)$ is bright red below 55°C, deeper red from 55-60° C, Chocolate from 50-70°C, grey between 70 and 91°C and black above 91°C. The yellow pigment $Ag^2(HgI_4)$ is yellow below 45°C, orange between 45 and 50°C and pale red above 50°C.

10. *Decomposition of Carbon Monoxide in Presence of Nickel as Catalyst.*

B. Chatterjee and P. P. Das, Sibpur.

The maximum decomposition of carbon monoxide in presence of nickel as catalyst has been found to take place at about 350°C, the corresponding temperatures with iron and cobalt being 550°C and 700° C respectively. The speed of the decomposition reaction, $2CO=C+CO_2$, increases with time up to about three-quarters of an hour and then decreases. The curve obtained by plotting the amount of carbon deposited against the temperature, shows another peak at about 500°C and in this respcet differs from those for iron and cobalt which show one peak each, at 550°C with iron and at 700°C with cobalt. The catalytic activity of nickel for this reaction has been found to be very small compared to thore of iron and cobalt. Further work on the decrease in the catalytic activity of nickel with time and increasing temperatures of reaction is in progress.

11. *The Engineering Properties of a Clay Loam Soil of West Bengal.*

B. Chatterjee and P. C. Ghosh, Sibpur.

The engineering properties of disturbed samples of a soil collected from Tollygunge (Calcutta) have been discussed. The results of some simple tests, such as measurement of grading, apparent density, moisture content at saturation, pore space, specific gravity, volume expansion, field moisture equivalent, shrinkage limit, shrinkage ratio, lower liquid limit, plastic limit and plasticity index, have been presented. A comparison of these results with the range of numerical values of the physical constants of different groups of soil (Chatterjee, Science and Culture, April, 1950) suggests that the soil under investigation belongs to the A-5 group as classified by Brown and Hogentogler (Roads and Streets, Vol. 81, No. 3, 1938). The observed properties of this soil indicate that it should be avoided, if possible, for any engineering enterprise. If unavoidable, this soil should be adequately densified or properly compacted as per specifications laid down by soil tests if it is to be used as fill or dam materials or inearth-dam constructions. For use in the highway and airport construction, the requiremrnts of this soil area : thick macadam or concrete pavement ; subgrade treatment by admixture with coarse constituents ; crack control and reinforcement ; oiling, etc.

12. *Studies on the behaviour of Cu-Mg alloys against atmospheric Corrosion.*

Dr. G. P. Chatterjee and Sri P. C. Mukherjee,
Shibpur Howrah.

Apart from their uses in Industry, Cu-Mg alloys are useful for the development of "Nodular" Cast Iron. Since these alloys (particularly those containing higher Mg-Content) are very much susceptible to atmosphere corrosion a programme of research was taken up to find out the alloying elements which would minimise loss of the Mg-content of the alloy. With this end in view several Cu-Mg alloys have been prepared with and without Al, or Mn. The reasons for selecting these elements have been discussed in another paper by one of the authors. This paper deals with the losses in weight per cent. of Cu-Mg, Cu-Mg-Al and Cu-Mg-Mn alloys when exposed to dry and ordinary atmosphere and also atmosphere saturated with moisture. The following results have been obtained :—

1. The atmospheric corrosion of ordinary Cu-Mg alloys appears to increase almost exponentially with the increase in the moisture content of the atmosphere.
2. The corrosion is very appreciably lowered by the addition of small amounts (less than 2 per cent.) of Al or Mn.
3. For humid atmospheres Al is more effective in retarding corrosion than Mn.

13. *Gas Absorption in Bronzes during Melting.*

A. T. Pal, B.Met., C.E.

In preparing phosphor-bronze alloy, the usual procedure adopted for the prevention of loss of tin as well as steam formation, both due to oxidation, lies in melting the copper under a thick layer of charcoal and also in adding Cu_3P as deoxidiser before tin is introdurcd. Finally, a further requisite quantity of Cu_3P is added in order to bring the phosphorus content to the desired limit.

But experiments have demonstratrd that no loss of tin or no steam formation takes place if the alloy be formed only under a thick layer of charcoal, the addition of Cu_3P as deoxidiser being entirely unnecessary. The idea that any absorption of hydeogen which might take place due to melting under charcoal does not produce any harmful efects, has also been established by metallogaprhic, hydraulic and mechanical tests.

Experiments were also carried out without charcoal where the absorbed oxygen was removed and loss of tin prevented by required amount of Cu_3P. The phosphorus per cent. was, however, fixed by further addition of Cu_3P finally. The amount of oxygen absorbed, as determined by the loss of total phosphorus, depends on three factors as time of melting, surface area of the melt exposed and the atmospheric conditions.

14. *A New Type of Age-Hardening Phenomenon.*

Dr. G. P. Chatterjee, Bengal Engineering College, Howrah.

A new type of age-hardening phenomenon has been observed in plain carbon steels which are anodically surcharged. This appears to be connected with the decomposition of supersaturated solid solutions where the supersaturation has been caused by pressure quenching (i.e., by quickly decreasing the pressure) rather than by the conventional thermal quenching. When a piece of hot forged and annealed steel sample, containing primairly C and Mn, is anodically surcharged, its hardness decreases. When this surcharged sample is allowed to age, the plot of Rockwell R_B hardness values as function of aging time t shows certain characteristics which may be considered as aging phenomenon of the pressure-variable type.

The following results have been obtained :—

(1) the first maximum hardness $R_{B_{max}}$ is conncected with t_{max} (the aging time to attain $R_{B_{max}}$) by the following relation :—

$$R_{B_{max}} = Be - a(t_{max})\tfrac{1}{2}$$

(2) t_{max} appears to be a parabolic function of the aging time t i.e., $t_{max} = kt\frac{1}{2}$

(3) the aging time t and $R_{B_{max}}$ are connected by the relation $R_{B_{max}} = K_2\, e\text{-}kt\frac{1}{3}$

(4) decarburisation as well as grain growth takes place during anodic surcharging.

15. *Malleablising of Cast Iron in Hydrogen.*

B. Chatterjee and P. C. Ghosh, Sibpur.

By heating a specimen of cast iron (C, 3.08 per cent.; Si, O. 88 per cent.; Mn, 0.216 per cent.; P, 0.29 per cent. and S, 0.09 per cent.) at 1000° C in hydrogen, a microscopic layer or skin containing much less carbon or even ferrite has been observed on the solid. The rate of decarburization in moist hydrogen, containing 1.2 per cent. moisture by volume has been found to be much faster than that in dry hydrogen. It has also been observed that the white cast iron used could be converted into hyper-eutectoid steel in six hours by annealing with dry hydrogen and that the speed of further decarburization was comparatively slow. In addition to the outward diffusion of carbon through the metal, the penetration of hydrogen into and diffusion of methane out of the solid specimen have been found to play an important role in the decarburization of cast iron in hydrogen. The withdrawal of methane seems to take place through the micro-pores present or 'micro-disturbances' caused in the metal under the conditions of the experiments.

16. *On the standardisation of the Relaxation Treatment of systematic pressure computations for overflow spillway discharges.*

S. K. Roy, Poona.

Though the designs of standard cases of overfall type of spillways can be based to a large extent on previous experiments, every individual case is however at present required to be subjceted to a model study. This note is an attempt to systematise the evaluation of field of flow and pressure characteristics on the crests of overflow spillways. Since the three dimensionality of flow and the viscous effect do not have appreciable influence, a two-dimensional relaxation treatment of the problem has been taken up, which is or sufficiently good approximation of the behaviour of flow in actual case.

The solution for a standard profile based on the flow past a sharp-crest, for any design head has been followed by the derivation of a method of avoiding much of the numerical analysis for the cases with different heads. The range of head under consideration varies from very nearly zero to twice the design head. The cases systematised can now be used, for check up of pressure on spillway crest profile for any head with very little labour so as to dispense with a large part of the routine testing of models for this aspect of the investigations.

17 *Effects of Anodic Surcharging on the Behaviour of some plain carbon steel.*

G. P. Chatterjee, K. C. Shome and R. Ganguly,
Sibpore, Howrah.

The so-called "Passive State of iron" which enables it to resist anodic attack and exhibit a comparatively positive electrode potential has been studied by many investigators. But the anodic behaviour of iron containing other elements, C, Si Mn, etc., as in plain-carbon steel-particularly the effects of anodic surcharging on the physical properties of steel, has not been studied so well. This paper deals with the effects of anodic surcharging on the hardness values of a plain-carbon steel and also the effects of subsequently aging these surcharged steels for different periods of times.

The experimental procedure consisted of hot forging a block of cast steel, annaeling the test pieces at 850° C, measuring the Rockwell R_B values before and after anodic surcharging with 0_2 for different periods of time and also after definite known periods of aging after surcharging.

The following results have been obtained :—

(1) Plain-carbon steel (hot forged and annealed) when surcharged with oxygen for different periods of time shows definite decrease in R_B hardnes values.

(2) The Rb values as function of surcharging time tend to obey an exponential law of the type :—

$$R_B = A_e^{-bt^{\frac{1}{2}}}$$

(3) On aging the steel after different periods of surcharge the hardness first increases up to a certain maximum R_B max., then decreases up to a certain minimum R_B min. and then tends to increase towards a certain constant value.

(4) The values of R_B max. and R_B min. are lower, the lower the period of surcharging.

(5) Decarburiasation occurs on surcharging.

18. *Hirakud Dam Project.*

Kumud Bhushan Ray.
Garia, (24 Parganas)

In 1945, CWINC proposed river control on TVA pattern by reservoirs in the Mahanadi Valley. A statement of discharges, number of reservoirs, and costs of River Valley Projects in USA and India, will give food for thought :—

River.	Maximum Discharge in Cusecs.	Mean—Annual Runoff in Acre Feet.	Number of Reservoirs.	Cost.
Colorado ..	300,000	17,729,000	134	Rs. 1,654 crores.
Tennessee ..	500,000	47,000,000	27	,, 408 ,,
Kosi ..	705,000	....	1	,, 100 ,,
Mahanadi ..	942,000	50,000,000	1	,, 47 ,,

TVA reservoirs have a life of 1,000 to 2,000 years. Hirakud Reservoir has a life of only 100 years, assessed on the assumption that Mahanadi waters move only 42,500 acre-feet of sediment load annually, or about 1/3rd the sediment load of 137,000 acre-feet moved by the Colorado, a river carrying only about 1/3rd the discharge of the

Mahanadi. For assessing the sediment load, water samples were collected in the Mahanadi at 0.6 depth only, as against at least 3 points in rivers in USA ; while a deposition of only 50 per cent., as against 100 per cent. deposition in large reservoirs in USA, was assumed. With proper collection of samples of water, the annual sediment load in the Mahanadi is likely to be over 137,000 acre-feet, as against 42,500 acre-feet. The life of Hirakud Reservoir would be 100/3 or about 33 years ; while if 100 per cent. of the sediment load is deposited, instead of 50 per cent., the life would become 33/2 or about 16 years.

It has been stated that the silting of Hirakud Reservoir should not cause anxiety as other dams would be constructed higher up on the Mahanadi and its tributaries In a democratic country like USA, it has been made public that the number of reservoirs needed in the Colorado Valley is 134 and cost Rs. 1,654 crores. It is desirable that the number of reservoirs and cost of Mahanadi Valley Project is also made public.

The Mahanadi is a much larger river than the Colorado, carrying nearly 3 time its discharge. The cost of the Mahanadi Valley Project will thus be well over Rs. 1,000 crores. Considering that THREE such projects are needed in Orissa State, such colossal expenditure seems to be beyond the financial resources of India. It appears that the Orissa Flood Enquiry Committees were right, when they stated :—

> "The construction of flood control reservoirs on any of the rivers was not practicable".

19. *Exchangeable ions and Engineering Properties of Soils.*

K. P. Shukla and C. M. Pant, Roorkee.

The influence of absorbed bases on the physical properties of soils have long been known but it is only as late as 1948 (Winterkorn, Proc, 2nd International Conf. Soil Mechanics Rotterdam Vol. 1, p. 23) that soil scientists have directed their efforts to elucidate their effect on some of the Engineering Properties. In the present study an attempt has been made to investigate more systematically the effect of absorbed bases of different valency on such Engineering Properties of soil as are used in the design of Earth dams, levees and foundations.

In order to prepare samples saturated with exchangeable ions the soil was first boiled with 6 per cent. H_2O_2 until it was free from humified organic matter, and afterwards leached with N/10 HCl in sufficient quantity to free it from oxides, hydroxides and carbonates. The resulting hydrogen soil was treated with respective chlorides of bases it is desired to saturate it with. Finally the excess salt was washed out by distilled water and later by absolute alcohol. The samples so prepared were tested to find out Atterberg's limits, compaction properties, moisture absorption, dispersion, shear characteristics, permeability and consolidation.

It was found that there is a regular gradation in the properties of soil saturated with ions of same valency and that they showed a pronounced change with a difference in valency. The moisture absorption capacity, liquid limit, plastic limit follows the lyotropic series.

$$\overset{1+}{\mathrm{Na}} > \overset{1+}{\mathrm{NH_4}} > \overset{1+}{\mathrm{H}} > \overset{1+}{\mathrm{K}} :$$

$$\overset{2+}{\mathrm{Cu}} > \overset{2+}{\mathrm{Mg}} > \overset{2+}{\mathrm{Ca}} > \overset{2+}{\mathrm{Sr}} > \overset{2+}{\mathrm{Co}} > \overset{2+}{\mathrm{Ba}} > \overset{2+}{\mathrm{Ni}} > \overset{2+}{\mathrm{Cd}} :$$

$$\overset{3+}{\mathrm{Al}} > \text{Methylene Blue.}$$

The dispersion Co-efficients follow the order.

$$\overset{+1}{\mathrm{Na}} > \overset{+1}{\mathrm{H}} > \overset{+1}{\mathrm{NH_4}} > \overset{+1}{\mathrm{K}} :$$

$$\overset{+2}{\mathrm{Cu}} > \overset{+2}{\mathrm{Cd}} > \overset{+2}{\mathrm{Co}} > \overset{+2}{\mathrm{Ni}} > \overset{+2}{\mathrm{Mg}} > \overset{+2}{\mathrm{Ca}} > \overset{+2}{\mathrm{Sr}} > \overset{+2}{\mathrm{Ba}} : \text{ and}$$

$$\overset{+3}{\mathrm{Al}} > \text{Methyline Blue.}$$

While permeability co-efficient follow exactly the reverse of the above order. The optimum moisture and maximum density figures in reverse order of each other vary in regular manner with hydration of the ion.

Shear characteristies '$\varnothing$' & 'C' ; The angles of internal friction $\varnothing$ vary in the order.

$$\overset{+1}{\mathrm{Na}} > \overset{+1}{\mathrm{H}} > \overset{+1}{\mathrm{NH_4}} > \overset{1+}{\mathrm{K}} ;$$

$$\overset{+2}{\mathrm{Cu}} > \overset{+2}{\mathrm{Cd}} > \overset{+2}{\mathrm{Mg}} > \overset{+2}{\mathrm{Co}} > \overset{+2}{\mathrm{Ni}} > \overset{+2}{\mathrm{Ca}} > \overset{+2}{\mathrm{Sr}} > \overset{+2}{\mathrm{Ba}} ;$$

$$\overset{+3}{\mathrm{Al}} > \text{Methylene Blue.}$$

While Cohesion 'c' follow exactly the reverse order. *Consolidation characteristies* 'a_v' and 'c_v'. The co-efficients of comprisibility 'a_v' follow the series of moisture absorption capacity and co-efficients of consolisation the reverse of it.

20 "*X-ray Diffraction studies of a binary alloy containing metals with dissimilar crystal structures, valencies and ionic radii.*"

Dr. G. P. Chatterjee, Howrah.

"This paper deals with the crystal structure of a particular AuBe alloy. This alloy has been selected because very little work has been done so far with Au-Be system and also because Be is a very useful material in nucleur research work. A moderator containing elements with low atomic number in its lattice but having such properties as high melting point, high resistance to corrosion and low absorption as high melting point • high resistance to corrosion and low absorption cross-section for neutron would indeed be a useful matellurgical material for the construction of power nuclear reactors."

Small pellets of Au and Be were prepared in vacuum quartz tube furnace. Pillets showing singlephase under the microscope were selected for X-ray diffraction after annealing the powder in vacuum at 400°C.

The following results have been obtained :—

(1) Au and Be form an intermediate phase $AuBe_5$ at about 84 atomic% Be

(2) $AuBe_5$ is face centered cubic but quite brittle and thus the lattice bond is not metallic.

(3) The density of $AuBe_5$ is 7.110 gm/cm^3.

(4) $AuBe_5$ has a lattice structure similar to the FCC ZnS type with slight modifications.

21. *Engineering Properties of Bundelkhand Soils.*

K. P. Shukla and C. M. Pant, Roorkee.

With a view to elucidate the distinctive characteristics of typical Bundelkhand Soils popularly designated as Mar, Kabar, Parwa and Rankar, representative samples were collected from all parts of region and their Engineering Properties studied in the light of their mineral constitution.

The different samples were treated in order with 6 per cent. H_2O_2 to destroy all organic matter, with N/20 HCl to remove oxides, hydroxides and carbonates and with N-$CaCl_2$ to saturate the exchange complex with calcium. Further, to eliminate the effect of difference in grading, they were made to possess identical mechanical composition namely : 42 per cent. clay, 38 per cent. silt and 20 per cent. sand by the process of sieving and mixing the fractions separated from a particular samples in adequate proportions.

After the sample were so prepared the limits of consistency, compaction properties, co-efficients of permeability, shear characteristics, moisture absorption capacity, co-efficients of compressibility and consolidation, found out. Also to know their probable structure the SiO_2/R_2O_3 ratio and the base exchange capacity were determined.

Apparently, the properties vary to a marked extent with the variation of SiO_2/R_2O_3 ratio and base exchange capacity, as illustrated by some of the results given below :

Soil.		SiO_2/R_2O_3.	Base exchange capacity m.e.	Co-efficient of permeability ft./yr.	Co-efficient of consolidation Cv.
Mar	..	2.08	53.42	0.006	$0.69X10^{-8}$
Kabar	..	1.42	48.32	0.044	$3.93X10^{-8}$
Parwa	..	1.26	38.70	0.213	$20.97X10^{-8}$
Rankar	..	1.12	39.49	1.125	$118.82X10^{-8}$

Such large variations could only be explained by the difference in crystal structure of clay minerals predominating soils. The first two types contain minerals of Beidellite and other two of Balloysite—Kaolinite groups. Also Parwa and Rankar are the products of decompositions of granite while Mar and Kabar seem to come from rocks of volcanic origin which from intrusions in regular Bundelkhand granite.

22. *Improvements in the Constructions of Partitions, Solid Walls, Plinth, Foundation, Bridge Piers, and similar other Structures.*

P. B. Ghosh, Calcutta.

The construction has been achieved by newly designed T-shaped bricks. In my previous papers, with the same blocks construction of hollow walls was illustrated. The present paper deals with construction of walls of thicknesses, such as 2½ in., 4 in., 5 in., 7½ in., 10 in., 12½ in., 15 in., 17½ in., etc., that is, the thicknesses increase by 2½ in. instead of by 5 in. with ordinary conventional rectangular bricks.

The chief merits of the construction consist in the fact the number of bricks required is less, varying from 20 per cent. to 30 per cent. and the quantity of mortar necessary is less by about 50 per cent., with increased strength and solidarity. The construction is also much quicker. No cutting of bricks and closers are necessary at corner joints as in English and other types of bonds. In the case of 4 in. walls the out look is novel and they act as deep beams, as there are no horizontal joints or layers. For the purpose of experimenting, walls have been made without any damp proof course, with these blocks arranged in the novel way as illustrated in the drawings.

23. *Estimation of Seepage Losses in Earthen Channels with a Steep Fall.*

K. P. Shukla & D. N. Bhargava, Bahadrabad.

The construction of power house on an existing channel necessitates the raising of water level upstream of the fall and lowering it suitably at downstream so that maximum advantage could be obtained from the natural slope of the ground. These operations increase seepage losses which need be determined before hand lest they do not materially effect the supplies.

In the absence of any other reliable method, recourse was taken to study the problem with the help of hydraulic models. A two dimensional scale model (1/48) of a section of channel was constructed with coarse sand. Maintaining a constant water level in the canal by means of overflow regulator seepage losses were determined at differen depths of spring levels. Reducing these figures to prototype conditions by multiplying with a factor, incorporating the ratios of the permeabilities of model and prototype materials, probable seepage losses occuring in the canal were obtained.

With the figures so arrived at a relation between dQ/dl, losses (in cu. ft. per sec.) taking place through elemental length dl of canal and the depth of spring level S, was worked out.

The follow equation seems to hold good :—

$dQ/dl = a\ S^b$ ....(1)

a & b being constants.

Because of the fall, spring level in total length of power channel varies regularly in a straight line given by (2)

$S = kl$ ....(2)

Where k = a constant.

From relations (1) and (2) and integrating for the total length L under consideration, we get

$$Q = \int_0^L a\,(kl)^b\,dl \quad \ldots\ldots\ldots\ldots\ldots(3)$$

Applying the method to the project of Pathri Power House on Ganga Canal with a fall of 31 feet and a power channel 3,500 feet long we obtained following values of the constants,

$a = 1.91 \times 10^{-4}$

$b = 0.85$

$k = 31/3500$

On snbstituting these values and carrying out the integration we obtain

$$Q = \int_0^{3500} 1.91 \times 10^{-4} \left(\frac{31}{3500}\,l\right)^{0.85} dl$$

$= 6.69$ cusecs

The method is being applied to the assessment of seepage losses on other power houses.

24. *Mechanism of Atmospheric Corrosion with Reference to some Copper Base Alloys.*

Dr. G. P. Chatterjee, Howrah.

Copper is an essential key material particularly for a country where the quantity and quality of copper ore are rather poor. Some copper base alloys have poor resistance against atmospheric corrosion. This paper deals with some aspects of the effects of Al and Mn on CuZn and CuMg alloys.

The basic mechanism by which Al and Mn imparts corrosion resistance to Cu-Zn and Cu-Mg alloys have been pointed out, The expectations from theory are amply borne out by experimental results—particularly in humid atmospheres.

The rate of atmospheric corrosion is not only lowered by the addition of Al or Mn but the law of the growth of film in the case of the Cu-Zn alloys changes over from the Parabolic to the logarithmic law.

The rate of milm formation dx/dt on CuMg alloys appears to obey a combination of parabolic and logarithmic law. The following mathematical equation has been derived in this connection.

$$x \frac{1}{a} \log (ax-1) = \frac{1}{a} \log (K_1 t + K_2)$$

Where x is the film thickness, t is the time and a, K_1, K_2, are constants.

The physical justification of the above equation from the standpoint of diffusion and quantum mechanical consideration have been indicated.

CuMgMn and CuMgAl alloys show trends to obey the logarithmic law of film formation. The reasons for this on the basic of the properties of Al_2O_3 and higher oxides of Mn have been indicated,

25 *Magnetic Amplifier with Stalloy Core.*

P. N. Das, Howrah.

High permeability materials like mumetal have, during recent years, been successfully used in magnetic amplifiers. Stalloy having low permeability is not as effective but since it is readily available it is worthwhile considering its possibilities.

Considering B-H curve as consisting of straight portions both in the unsaturated and saturated regions and taking a very steep curve for the former and an almost horizontal curve for the latter, the fundamental transductor relation $\frac{I_a}{I_c} = \frac{T_c}{T_a}$ have been derived from very straightforward considerations. This assumption is justified for mumetal and similar cores but for stalloy the permeability is finite and the fundamental transductor relation can be shown to be

$$\frac{I_a}{I_c} = \frac{T_c}{T_a} - \frac{I_{sat}}{I_c} \cdot \frac{T_c}{T_a} + \frac{E_m}{\pi \cdot Lw \cdot I_c}$$

where I_{sat} is the d,c. current required to bring the working point just to the saturation region, E_m is the maximum value of applied a.c. voltage which is sinusoidal and which is not of very large magnitude so that the working point normally in the saturated region by the control current may not go very far into the curved portion of the unsaturated region and Lw is the inductive reactance of the coils in the unsaturated region.

Thus with small values of applied a.c. voltage, current amplification is less than the corresponding transductor with mumetal core, but with high value of applied a.c. voltage, current amplification may be made even larger. The greatest drawback with stalloy cores is that transductor characteristics, i.e., relations between applied a.c. voltage and rectified output current are not independent of a.c. voltage as in the case of mumetal cores but output current increases with applied voltage and although rate of increase can be minimised by special devices, they will not be found suitable for many applications. Stalloy core magnetic amplifier can, however, be used with advantage as a d-c amplifier where the signal input is of high magnitude as in the case of later stage of d-c amplification.

Thus maximum number of turns of feed back winding that can be given with advantage under different conditions, has been found out both in the case of high permeability cores and stalloy cores of less permeability and the maximum amplification that can be derived under these conditions has been discused :—

26. *Fuse-Breaker Co-ordination for Primary Distribution System.*

M. L. Dasgupta, Calcutta.

In this article the author describes how properly co-ordinated fuse could replace costly equipment like a circuitbreaker or other circuit interrupting devices for protecting 23,13,11,6 or 4 K,V. overhead primary distribution circuits. The time-current charecteristic of the fuse to be installed on the line is co-ordinated with the time-current charecteristic of the Induction type overcurrent relay at the Distribution Sub-station to operate the circuit breaker in case of fault on the line and this works in collaboration with another equipment known as the "Recloser". The characteristic curves have been plotted on log-log paper for illustration by assuming certain fault currents. The different step for making the co-ordination study are as follows :—

(a) A one line diagram showing transformer ratings, voltages and other details of the circuit to be protected is first drawn.

(b) Next we need to calculate the fault current for different types of faults at various locations of the circuit so that we are in a position to select the relay setting and choose the proper size of fuse link to give necessary protection.

(c) Lastly we can protect the transformer by a suitable primary fuse which has to be co-ordinated with the transformer damage curve if it is available.

Results obtained by the fuse-breaker co-ordination may be summarised in the following sequence :—

(1) As soon as a fault comes on the line, the instanteneous attachment of the overcurrent relay operates to deenergise the circuit by opening the breaker at the sub-station instanteneously.

(2) The Recloser now comes into operation to reclose the breaker immediately, In the meantime the trip is transferred to "Time delay element" of the relay. For a fault of transient nature this operation means automatic restoration of service with the recloser resetting it to its original position for future operation.

(3) However, if the fault still persists, then during the interval that the trip was taking through the time delay element the particular sectionalising fuse will blow off thus isolating the faulty section. And in case the fuse fails to respond, the breaker will be tripped by the time delay element.

Another equipment known as the "Short circuting contactor" has been added to build up fault current at the end of the line or on long branches where the fault current become so low as to be hardly within the minimum relay pick up. The contactor operates in about 2 cycles after the initiation of the fault.

27. *Commutation in Direct Current Machines.*

Dr. M. L. Jain.
Jadavpur, Calcutta..

After stating the problem of commutation from the points of view of electromagnetic couplings and electromegnetic energy, the paper gives equivalent circuit and differential equation for one of the coils under commutation, Clear definition of parameters involved in the equation and methods of their evaluation have been stated. The effect of pole leakage of the self and mutual inductances has been discussed rather at length, because this effect is omitted in available literature. The modes of desirable current variation including the wellknown linear variation, in the coil under commutation have been discussed. A graphical method of solving the differential equation has been described. This method involves no assumption in regard to contact resistance. This brings out clearly the limit to the efficacy of commutating pole,

28 "*Computation of thermal characteristics of oil-immersed power Transformers Graphical methods.*"

A. Srinivasan, Anantapur, Madras.

The temperature rise of an oil immersed transformer is given by the fundamental differential equation $W = \lambda\theta + c. \dfrac{d\theta}{dt}$ where

W=Total losses of the transformer.
λ=heat-transfer coefficient.
θ=Temperatur rise.
c=Thermal capacity of the transformer,

The final solution of this equation is $\theta = \theta_i + (\theta_n - \theta_i)\left(1 - e^{\frac{-t}{Tr}}\right)$

where θ_i=initial temperature.
θ_n=ultimate temperature
and Tr = Thermal time constant of the transformer $c = . \dfrac{\theta}{W}$

The above equation when plotted on a special logarithmic paper whose abxissa is the function $\frac{t}{T}$ and the ordinate is temperature is a straight line and thus permits the calculation of temperature rise at any time of the load by interpolation.

When the transformer is subjected to an over load the lorks are increased and as result the temperature rise also is increased by a factor $\gamma = \left[\dfrac{Rp^2+1}{R+1}\right]^{0\cdot 8}$ where R=ratio of lorks and P=ratio of over load to full-load, The calculation of γ also is rendered simple by a special log-scale construction.

The efects of a recurrent load cycle on the transformer can be very easily calculated by the use of the above constructions. Transformers are intended to operate so that under no condition the hot-spot temperature exceeds 105°c, and keeping that temperature as the ceiling valve, any transformer can be intelligently loaded to get the utmost output. The graphical methods developed in this paper render the calculations very easy for an operating engineer to study the entire thermal behaviour of a power transformer,

29. *Long distance scattering of radio waves and undulations in the ionosphere.*

S. S. Banerjee, R. R. Mehrotra and V. D. Rajan, Banaras.

Reception of short wave radio signals has been obtained for high power transmissions from Delhi due to scattered energy as evidenced by the frequency of transmission which was much higher than the maximum usable frequency and also by the disappearance of the ordinary and extra-ordinary components of the wave obtained in the fading records. The occurrence of such receptions have, however, been found to be associated with the undulations in the ionosphere which presumably help in the concentration of energy at the receiver. The possibility of such enhancement of energy due to undulations has been further corroborated by our recent observations of long distance scattering with a low power pulse transmitter. The possibility of estimating the dimensions of these undulations has also been discussed.

30. *The Determination of the average with golimotive Force expended on the tapered Teeth.*

K. S. RANE.

Standard methods for accurate determination of the average MMF expended on the tapered teeth involve considerable graphical and calculation work, F. W Carter and O. I, Butler have developed methods in which the problem is solved with the help of a family of basic curves, but the labour involved in constructing these curves is great· With a slightly different approach to the problem, the author has shown that F.W. Carter's method can be so modified as to reduce the labour in working out curves which will serve the same purpose, The paper outlines the theory, method of construction and use of the modified curves. A comparison with other methods is aldo made.

31. *Equivalent paths of the extra-ordinary waves for oblique incidence at the ionosphere.*

S. S. Banerjee and R. R. Mehrotra, Banaras.

An equation showing the vaziation of the equivalent path of the extra-ordinary wave at oblique incidence in the ionosphere has been developed. This equation is useful for drawing the curves showing the relation between the equivalent path, critical frequency and semi-thickness of the ionospheric layer which are of considerable importance for finding the characteristics of the ionosphere. Further, from these curves and the fading patterns obtained near the maximum usable frequency, it is possible to estimate the slow rates of change of electronic density and semi-thickness of the ionospheric layer.

32. *Problem of Electrical Insulation.*

S. Sharan

Tbe paper with the following pooblems of electrical insulation :—

(i) Electrical Strength of materials

(ii) Dielectric loss.

(iii) Dielectric constant and materials having high dielectric constant,

It summarises the work of several workers in this field including that of the author and presents an up-to-date understanding of the above problems in terms of molecular and crystalline structure. It further points out the possibilities in this field towards the development of new materials,

33 *Dielectric Phenomenon in High-Voltage Transformers.*

R. C. Pal

Dielectrics play an important part in the design and construction of power and instrument transformers. The dielectric loss as well as the ratio of a transiormer having appreciable capacitances between windings, depend upon whether and how the windings are connected together :—

In selecting dielectrics for a transformer, the following; important points should always be considered :—

(1) Puncture strength of the dialectric,

(2) Maximum voltage that may be subjected across a dielectric during the most abnormal condition, which may occur due to either lightning, switching surges or arcing-grounds.

(3) Power ol dissipation of heat of a dielectric.

(4) Minimum size and cost of a transformer for a given KVA capacity,

The effects of unevenly distributed voltage on the H. T. winding due to different causes and the various ways of obtaining a more uniform voltage distribution and minimising the effects of voltage oscillations are discussed.

Considering different dielectric circuits present in a transformer, the author calculates the dielectric loss for a 1,000 KVA, 33,000/400 volts, 3 ph., 50 cycles power transformer, though uptill-now this loss was included in the core-loss. To show the effect of dielectric admittances upon the transtormer-ratio, the author assumes here a system of lumped inductances and capacitances, though actually they are of distributed nature, and developes a formula for the voltage ratio to indicate its diffreence from the turn-ratio.

34. *Effect of Undulations in the ionosphere on the fading patterns.*

M. Sengupta, S. S. Banerjee and G. C. Mukherjee, Banaras.

It has been observed that the presence of undulations in the ionosphere considerably modifies the fading patterns particularly near the maximum usable frequency. Due to these undulations, the reflected beam maybe converged or diverged at the receiver depending on their curvature and produce variations in the intensity of the signals. Typical fading patterns showing the presence undulations have been given and their effcts on different magneto-ionic components have been shown. The possibility of finding out the direction and rate of movement of these undulations have also been indicated.

35. *A Preliminary Vibration Experiment on the Khadakwasla dam (Poona, India).*

S. L. Banerjee, S. K. Guha and Gurdas Ram.

The nature of the dynamic response of a structure like a dam during forced vibrations, as in an earthquake, is controlled among other factors by the free period of the system, the predominant periods of the extranous force, and the damping characteristics of the system. In this context, a preliminary investigation aimed at evaluating the dynamic charactaristics of a masonry dam at Lake Fife in Poona was undertaken. Fall of water over waste-weir on the rocky bed was utilised to set the structure in vibrations and these were recorded by a Wood-Anderson seismograph. Under the conditions of the experiments, these records provide a reliable value for the natural period of the dam and from that an approximate is made for the value of the Young's modulus of the dam-material in situ. The effects of the elastic foundation and that of the water load on the upstream face, on the natural period of the dam are also discussed. The necessity of further controlled experiments with the reservoir full and again when it is empty is emphasised. For it would enable a proper estimaon of the enhancement in the damping factor and the increment in the free period of the system brought by this upstream water load.

SECTION OF PHYSIOLOGY

President—Dr. Sachchidananda Banerjee, M.Sc., M.B., D.Sc.

ABSTRACT

1. Some observations on tests designed to assess functional efficiency of circulatory and respiratory systems and general fitness.

D. N. Bagchi and S. N. Banerjee, Cuttack.

The following tests were carried out on groups of healthy medical students and values recorded and compared with standard given in literature :—(1) Vital capacity, complemental, supplemental and tidal air ; (2) Breath holding test ; (3) Maximal breathing capacity ; (4) Expiratory force test—the manometer test ; (5) Persistence test—endurance or fatigue test—40 mm. test ; (6) Exercise tolerance test ; (7) Pulse pressure and diastolic pressure ratio—Moot's formula and Schmeider's test. A comparative value of these tests, on the same group of individuals show that while oud values in breath holding test, expiratory force test, Moot's formula and Schneider's index are at par with standard given in literature. The vital capacity is 82 per cent, maximum breathing capacity is 71 per cent, Crompton value and effort tolerance are 66 per cent below the normal value. These tests are hardly reliable for the assessment of general health of an individual.

2. Cuttack climate and comfort.

R. N. Sen *and* S. M. Banerjee, Cuttack.

From Kata thermometer readings taken in Cuttack during different months it is deduced that comfort conditions are likely to exist only in the months of November, December, January and February. The rest eight months in the year remain uncomfortable, the worst months being May, due to high external temperature and August and September due to high humidity. The attention of the Public Health authorities is drawn to this serious aspect adversely affecting the health and efficiency of the working people.

3. Study of normal bone marrow cytology in Orissa.

U. N. Dash and S. M. Banerjee, Cuttack.

Bone marrow cytology was studied in 15 normal individuals. The sizes of different cells were similar to those found by others. The average total count of all marrow cells was 5. 2 millions per c. mm. The total count of all nucleated cells of bone marrow was 60,000. The differential counts of these cells revealed that the myeloid series including pregranulocytes and granulocytes constituted 66 per cent. The erythroid series of cells constituted 26.23 per cent ; megakaryocytes, 0.40 per cent ; lymphocytes, 7 per cent and monocytes, 0.32 per cent.

4. Haematological studies in students and nurses of Assam Medical College.

B. Banerjee, Dibrugarh.

In order to find out the normal haematological standards of the middle class population in Assam the haematological studies were undertaken in three categories of people in Assam Medical College namely male students, lady students and female nurses. It was found that the haematological pictures of the first two categories of people of ages varying between 18 and 24 years under an average diet compared favourably with set standards. The nurses of age group 17 to 27 years showed a tendency towards macrocytosis and hypochromia. The diet consumed by nurses were comparatively of inferior quality and quantity.

5. Haematological and biochemical studies in normal adult women of nursing profession.

S. Chaudhuri, K. Mitra and S. Swaroop, New Delhi.

The subjects came from middle class homes and were following the profession of nursing either as students or as qualified nurses. The ages of the subjects varied between 16 and 30 years and the heights varied between 4 ft. 10½ inches and 5 ft. 4 in. The body weights varied between 80 lbs. and 129 lbs. All the subjects were in normal health. Haemoglobin ranged between 10.70 gm. per 100 cc. and 15.89 gm. per 100 cc. In the majority of the subjects the red blood cell counts were 4.5 million per c. mm., the range was 3.4 millions to 5.3 millions per c. mm. The cell volume varied between 30 mm. and 49 mm. per cent. Plasma protein ranged between 3.5 gm. and 7.8 gm. per 100 cc. The albumin and globulin ratio varied a good deal. The maximum figures for albumin was found to be 5.4 gm. per 100 cc. and that of globulin 4.8 gm. per 100 cc. The minimum figures for these two constituents were 1.3 gm. and 1.2 gm. per 100 cc. respectively.

6. Standard and maximum urea clearance values of apparantly healthy individuals in Orissa.

J. M. Senapati and K. Subrahmanyam, Cuttack.

The urea clearance value of a number of apparantly healthy individuals of ages varying between 20 and 30 years was determined to assess the kidney efficiency of normal people in Orissa. The maximum clearance value (Cm) and the standard clearance value (Cs) were found to be 51.9 cc. per 1.73 sq. meter and 64.3 cc. per 1.73 sq. meter which figures are only slightly less than the normal values based on American investigations and not so low as reported by Pai, Gokhale and others.

7. Studies on the basal metabolic rate and its variation amongst the Assam Medical College students and nurses during the winter season.

B. Banerjee, Dibrugarh.

In order to find out the normal basal metabolic rate (BMR) and the influence of climate, diet and occupation on the population of Assam, the BMR of 136 individuals in three different categories namely male students, lady students and female nurses were undertaken during the winter season of 1950-51. The Dubois normal standards as modified by Boothby and Sandiford were adopted and Benedict Roth metabolism apparatus was used with all necessary precautions. The BMR of male students were 7.1 per cent below Dubois standard. The female students were 7 per cent below and the nurses were 5 per cent below the above standard. It was observed that the BMR obtained by using Read's formula did not tally with the BMR obtained by Benedict Roth metabolism apparatus. BMR obtained by using Jenkin's formula compared roughly with the actual determination results with the male students but for the female students it did not bear any similarity. These observations suggest that there is no perfect co-relation between BMR and the pulse frequency and pressure and Reid's formula or its modification should not be used for accurate determination of BMR.

8. Influence of thiouracil and thyroxine on resistance to experimental tuberculosis in mice.

S. R. Sengupta, Calcutta.

Diverse opinions have been expressed in the literature on the possibility that the thyroid gland may influence to modify resistance or susceptibility to tuberculosis while many seem to believe that, of the endocrine glands, the thyroid rarely suffers from tuberculosis. Moreover, certain observations made in the laboratory and the field complicated the subject further and made it more controversial. In the face of such evidence in the literature, it seemd worthwhile to make an experimental approach with appropriate laboratory animals as it was clear that there was a prima facie case for examining the effect of thiouracil and thyroxine on resistance to tuberculosis.

The observations were made on white Swiss mice. The mouse proved to be a particularly suitable animal for this type of experiments. The mice were inoculated intravenously with H 905 strain of tubercle bacilli. A modified Sherman-B diet was used as the basal diet on which the animals were bred and fed. In all the experiments other factors such as housing, age, sex, body weight, heredity, previous contact with infection and the infecting dose. were equalised between the two experimental groups and only their diets were different. As a measure of resistance the survival time and survival rate of adequate groups of animals, the extent and character of the lung lesions in animal killed both at the end of experiments and at pre-determined times after infection were used as criteria. By all these criteria, the mice fed on the basal diet supplemented with desiccated thyroid extract showed higher resistance than those fed on the basal diet supplemented with thiouracil.

9. Studies on the role of acetone bodies on carbohydrate metabolism.

M. C. Nath and V. K. Sahu, Nagpur.

Subcutaneous injection of both sodium acetoacetate and glucose have the effect of raising the blood sugar. When the injection of sodium acetocaetate was immediately followed by the subcutaneous injection of equimolecular amount of glucose, practically no effect on the blood sugar tolerance curve was observed. The condensation product of sodium acetoacetate and glucose even upto 223.2 mg. per kg. had no effect on the initial blood sugar value. After subcutaneous injection of sodium acetoacetate in high doses (341.7 mg.|kg.) in a normal rabit albumin appeared in the urine, the specific gravity of the urine increased and there was increased diuresis. But no abnormal effects were observed when the high does of acetoacetate was immediately followed by its equimolecular amount of glucose. The condensation product of glucose with ethyl acetoacetate had practically no abnormal effect in the system. Sodium acetoacetate was found to inhibit glucose utilization when present in an amount greater than half the equimolecular amount of glucose taken in the experiment. On further increasing the amount of acetoacetate the inhibition became more and more pronounced till a complete inhibition of glucose utilization was observed. The condensation product was found to be without any inhibitory effect even upto an amount equal to the equimoleular amount of glucose. On increasing the amount of the condensation product inhibition of normal glucose was observed but it was less than the corresponding amount of acetoacetate in the free state.

10. Inhibition of ¾-SH enzymes by intermediary fat metabolites.

M. C. Nath and J. S. Gadgil, Nagpur.

Acetoacetate exerts an inhibitory effect on the urelytic activity of urease. At the concentration of 0.5 mg. of acetoacetate per cc. of the reaction mixture no inhibitory effect is observed. At higher concentrations the degree of inhibition increases gradually and at a concentration of 5.0 mg. per cc a complete inhibition is observed.

11. The effect of intermediary fat metabolites on the process of transmethylation in liver.

M. C. Nath and M. B. Dongre, Nagpur.

The process of transmethylation in the liver has been studied in presence of acetoacetate. It has been found that acetoacetate below certain concentration (0.04 mg. per cc) does not inhibit the process of transmethylation. At the concentration of 0.1 mg. per cc and above there is complete inhibition of the process.

12. Methionine excretion in lathyrism.

M. N. Rudra, Laherissarai.

Methionine excretion in Lathyrism and in normal persons has been assessed. The values are 84 ± 49 and 447 ± 120 mg. in 24 hours respectively. The lower excretion in lathyrism is due to a toxic factor present in kheshari and other grains producing lathyrism.

13. The effect of lactose and galactose on the utilization of fat.

T. A. Venkitasubramanian and S. S. De, Bangalore

To clear up the conflicting opinion about the effect of lactose and galactose on the utilization of fat using the single food choice method the effect of lactose and galactose on the utilization of ground nut was studied. The effect of the nature of the fat on the utilization of these two sugars was also studied. Cocoanut oil and groundnut oil did not make any difference in the utilization of these two sugars.

14. Proteins of Pituitary (Posterior) lobe extract : Effect of irradiation as observed by ultraviolet absorption spectra.

S. K. Ganguli and Rabindra Nath Bhattacharya, Calcutta.

The ultraviolet absorption curves of the proteins of pituitary (posterior) lobe extract on irradiation with ultraviolet light for different periods were recorded with a Beckman Quartz Spectrophotometer fitted with a hydrogen discharge tube and 1 ccm absorption cells. After irradiation the maxima and minima of the curves were not appreciably altered. The shifting of the curves, however, occurred as a result of the changes taking place in the extinction values. The same again was found to be in agreement with the ultravlolet absorption curves of proteins and certain amino acids, tyrosine, tryptophane, phenyl alanine after treatment with ultra violet light.

15. Proteins of pituitary (posterior) lobe extract : Reactivity against 2 :6-dichlorophenol indophenol.

S. K. Ganguly, Calcutta.

Reactivity of the proteins of pituitary (posterior) lobe extract with 2:6-dichlorophenol indophenol under conditions when the reaction is specific for sulfhydryl groups in proteins have been studied. 0.25 per cent acetic acid extract prepared from acetone dried pituitary (posterior) lobe powder of varying potency and a solution prepared from concentrated purified hormone have been used in the investigation. The reactivity is recorded in the form of a graph where the time factor for the decolorization of the indicator in varying concentrations are recorded. The indicator-time relationship for the reactivity of the extract prepared from a pituitary (posterior) lobe powder is indicatd by a straight line in the graph. There was a marked deviation in the reactivity in the case of extracts prepared from powder with low potency. A more concentrated and purified extract was also reactive to the oxidation-reduction indicator and the reactivity was in the decreasing order with dilution.

16. An observation on the pH and alkali reserve content of blood in cases of carbon monoxide poisoining.

S. K. Chatterji and Amiya Ghosal, Calcutta.

Poisoning from carbon monoxide is quite common in the Western countries and not uncommon in the East as well. The death in such cases is rather low painless unless the pressure of the gas inhaled is suddenly raised and is due to anoxia. There is no specific toxicity of the gas. The blood in these cases is bright pink in colour and gives the charaleristic carboxyhaemoglobin band when viewed through a spectroscope.

With an idea to determine the pH and the bicarbonate content of blood in such cases samples of freshly drawn human blood were used. Each sample was divided into two parts. Coal gas was passed through one parttill it got saturated and gave the characteristic band under spectroscope. They were then tested for their pH value by matching against standard buffer solutions of known pH using phenol red as indicator in both the cases. The bicarbonate content was determined according to the method of Lehmann. No change was noticed either in the pH value or in the alkali reserve content of the blood before and after they were treated with carbon monoxide gas.

17. Comparative value of the different methods of estimation of plasma proteins.

J. M. Senapati and K. Subrahmanyan, Cuttack.

The total plasma proteins were estimated by the accurate micro Kjeldahe method and compared with the specific gravity Haemoglobin method, which may be employed in clinical observations. The determination of plasma proteins from the specific gravity of blood and haemoglobin per centage was found to yield results about 20 per cent lower than by the micro Kjeldahe method in a majority of cases. As shown in another series the determination of plasma proteins from specific gravity of blood plasma gives, however, better results.

18. Amylases of butyl organisms.

Durlav K. Roy, Calcutta.

A number of butyl organisms were grown on potato-glucose-ammonium sulphatechalk media at 55°C for three days. Their cell-free filtrates were analysed for a variety of amylases. It was observed that the cell-free filtrates contain alpha amylase, beta amylase (cyanide labile), limit dextrinase and maltase besides other enzymes. It seems that the breakdown of starch molecules to glucose units is caused by the conjoint action of these amylases.

19. Distribution of digestive enzymes in Malphighian tubes of cockroach (Periplanata americana).

M. M. GOIL, Bareilly.

It is generally accepted that the Malphighian tubules in insects which open at the proximal end of the hind gut are excretory in function, though a number of workers recently reported the possibility of the presence of digestive ferments in them. In order to verify and to ascertain the nature and the presence of the enzymes in the Malphighian tubules of the cockroach, a series of experiments were conducted. The tests for the ferments amylase, trypsin, inulase, lipase and pepsin were conducted and it was found that traces of pepsin and trypsin were present.

20. A new colour test for vitamin B1.

K. C. PATNAYAK, Cuttack.

A green colour is formed when 1 cc of 1 per cent sodium nitroprusside solution and 1 cc of 10 per cent sodium hydroxide solution, freshly mixed, are added to 1 cc of a solution containing vitamin B1. The colour remains unchanged for about 15 minutes to half an hour. The test is not given by carbohydrates, proteins, fats, urea, uric acid, creatinine and ascorbic acid. The test is sensitive up to 0.001 per cent solution of thiamine.

21. Studies on the effect of sodium acetoacetate on thiamine.

M. C. NNATH and C. H. CHAKRABARTY, Nagpur.

Repeated injections of sodium acetoacetate to rabbits with increasing doses begining with 150 mg. per kg. body weight increases the blood pyruvic acid level from 0.94 mg. per cent to 2.72 mg. per cent after three months' injection. The daily urinary excretion of pyruvic acid is also increased from 2.82 mg. to 21.4 mg. The puruvic acid contents of blood and urine become normal after subcutaneous injection of thiamine.

When 100 gamma of thiamine is incubated at 37°C for 24 hours at pH 7.4 with 300 mg. of sodium acetoacetate 71 per cent destruction of thiamine takes place whereas in the control only 20 per cent thiamine is destroyed. When 300 gamma of thiamine is heated on a water bath with sodium acetoacetate for 3 hours at pH 6 88.5 per cent of thiamine is destroyed as against 19 per cent destruction in the controle experiment.

22. Thiamine and ascorbic acid contents of saliva and gastric juice of normal individuals.

K. C. PATNAYAK, Cuttack.

Thiamine and ascorbic acid in saliva and gastric juice have been determined by diazotized para amino acetophenone and 2:6-dichlorophenol indophenol respectively. The average percentage values of these vitamins in 30 samples of saliva and 10 samples of gastric juice obtained from normal individuals are: Saliva. thiamine value-0.93 gamma per 100 cc, ascorbic acid value 107.5 gamma per 100 cc. Gastric juice. Thiamine content 7.43 gamma per 100 c and ascorbic acid content 318.7 gamma per 100 cc.

23. Effects of levels of fat and protein on the intestinal synthesis of thiamine in rats.

S. Balakrishnan and S. S. De, Bangalore.

Urinary and facal excretion of thiamine were studied in rats fed diets varying in fat and protein levels and deficient in thiamine. The results seem to indicate that fat enhances the intestinal synthesis of thiamine and a high protein level help in that direction.

24. Biosynthesis of nicotinic acid in germinated pulses.

S. Banerji and N. C. Ghosh, Calcutta

Nicotinic acid contents of pulses are increased after germination. Along with the increase in the nicotinic acid content, trigonelline and N'methyl nicotinamide contents are diminished. Sodium cyanide and sodium flouride inhibit the breaking down of trigonelline and NMN and formation of nicotinic acid. When pure trigonelline hydrochloride solution is incubated with dialysed extracts of 48 hours' germinated *phaseolus mungo* nicotinic acid is liberated and the concentration of trigonelline hydrochloride in the solution is diminished. When pure NMN is incubated with the same extract no nicotinic acid is formed but NMN is diminished. It seems that nicotinic acid is formed from trigonelline and NMN does not play any part in the process.

25. Urinary excretion of N'methylnicotinamide by rabbits.

Dhurjati P. Chattopadhyay and N. C. Ghosh, Calcutta.

N'methyl nicotinamide (NMN) is a normal metabolic end product of nicotinic acid or nicotinamide in man, dog, cat and rat. Rabbits excrete a very small amount of N-MN and it is said that metabolism of nicotinic acid is different in this animal as compared with the metabolism of other animals. N-MN is unstable in alkaline solution and as the reaction of urine of rabits varies between pH 8.8 and pH 9 it might be possible that the alkaline reaction of urine destroys N-MN formed in the body. Rabbits were fed mandelic acid, 60 mg./kg., to change the reaction of urine. After administration of mandelic acid pH of the urine became 7.5 and the rabbits excreted an increased amount of N-MN. After injection of nicotinamide along with the administration of mandelic acid there was a considerable increase in the urinary excretion of N-MN. N-MN, therefore, is one of the metabolic end products of nicotinic acid metabolism in rabbits.

26. Studies on the bio-synthesis of ascorbic acid.

N. C. Ganguli and S. C. Roy, Calcutta.

The rat can synthesise ascorbic acid in course of its normal metabolism. This synthesis is greatly stimulated under narcotics, particularly chloretone and results in an enhanced urinary excretion of the vitamin by the animal. This process can be very nearly suppressed by the daily administration of a definite dose of ATP or malic acid to the rats. It has also been observed that less ATP is formed in the liver of the chlretonised rats than the normal.

27. Blood changes in scurvy.

C. Deb and S. Banerjee, Calcutta.

In order to find out the changes in blood in scurvy, red blood cells, white blood cells and reticulocytes were counted and the percentage of haemoglobin and cell volume were determined and a differential count of the white blood corpuscles were undertaken in both scorbutic and paired fed normal guinea pigs. Iron balance studies and examination of a stained film of bone marrow were also undertaken.

Iron balance studies showed that the anaemia of scurvy was not due to deficiency of iron in the diet. A decrease in the red blood cells and in the percentage of haemoglobin together with an increase in the reticulocytes and a normoblastic bone marrow were observed in scorbutic guinea pigs which indicated that the anaemia was due to retardation of the process of maturation of red cells. The mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration showed that the anaemia of scurvy is of normochromic normocytic type. There was a decrease in the total white blood corpuscles, neutrophils, lymphocytes and eosinophiles. The monocytes and basophils showed no change.

28. Molecular disitllation of shark liver oil.

T. Venkitasubramanian and S. S. De, Bangalore.

Shark liver oil was taken up for molecular distillation for concentration of vitamin A. A centrifugal cyclic batch molecular still of the DPI type was used. From a crude shark liver oil of initial activity 20,000 I. U. per gram by one single cycle of distillation the vitamin A was concentrated twenty times in the fraction distilling at 190-200°C at 1.5 micron pressure. The whole of the vitamin A was concentrated in one twentieth of the original volume. The total amount of vitamin A recovered was 96 per cent of the total present while the percentage loss in the oil was 4.5 per cent. The colour and smell of the concentrate was very much improved. Even with shark liver oil of low initial activity of about 1000 I. U. per gm. the concentration was good.

29. Effect of germination on the vitamin E content of pulses.

H. P. Chattopadhyay and S. Banerjee, Calcutta.

Vitamin E content of pulses, both before and after varying periods of germination, was estimated by a chemical method which gave the total tocopherol content of the pulses, In the 12 varieties of pulses studied it was observed that pulses contain considerable amounts of vitamin E. After germination there was a considerable increase in the total tocopherol content of pulses. Peas (*pisus sativum*), gram (*cicer arietinum*) and green gram (*phaseolus mungo*) were richer in their tocopherol content than the other varieties of pulses studied, which increased greatly during the course of germination. The increase was specially marked after 48 hours' germination and continued to increase upto 72 hours of germination after which the rate of increase slowed down and the increased value was retained upto 96 hours of germination. The results indicated that the germinated pulses are nutritionally superior to the ungerminated pulses even with respect to their vitamin E content.

30. Mutual supplementation in vegetable proteins.

B. M. PAL and S. S. DE, Bangalore.

The various oil cakes, which are a rich source of protein, can be processed so that these may be used for human consumption. These cakes, however, have a low biological value ranging from 55 to 60. To find if a mixture of different oil cakes would increase the biological value, the biological value was determined by the nitrogen balance method in several mixtures of oil cakes such as copra, cotton seed, sesame, soya and ground nut. Yeast and wheat were also used. Of the several mixtures tried in this study it was found that one mixture consisting of wheat, peanut and cotton seed gave a biological value of 70, while the other consisting of peanut, soya and sesame gave a value of 73. Other mixtures showed little or no increase in biological value.

31. Studies on balanced food.

B. M. PAL *and* S. S. DE, Bangalore.

A balanced food has been processed from some of the oil cakes, tapioca flour, yeast and other cheap sources abundantly available in this country. The food is in the form of macaroni and can be easily cooked by boiling with water. The food if taken as such is quite palatable, but when taken with dal and vegetable preparations its taste improves considerably. Feeding trials conducted on young albino rats have shown that the food has a high supplementary value to the poor rice diet and also it is a fairly balanced food by itself.

32. Amino-acid composition of Indian food-stuffs.

S. C. BALASUBRAMANIAN, M. RAMCHANDRAN, T. VISWANATHAN and S. S. DE,
Bangalore.

Four essential amino acids, lysine, methionine, phenyl alanine and histidine have been estimated microbiologically on eighteen samples of cereals consisting of different varieties of rice, wheat, cholam, cambu and ragi. Leuconstoc mesenteroids P-60 is the organism employed and the results have been critically evaluated by means of recovery experiments, agreement with literature values etc. In general all the samples are low in lysine and histidine compared to good quality protein foods like egg and casein. The total proteins have been isolated from certain cereals and amino acid analysis carried out on the isolated protein does not present the same picture as when the analysis is carried out on the food-stuff. The lysine content of some cereal flours have been found to decrease on storage.

33. Vegetable milk from soyabean, groundnut and ragi.

D. K. NANDI and S. S. DE, Bangalore.

A malted vegetable milk from soyabean and groundnut has been prepared having the following composition: Total solids, 12.5 per cent; Carbohydrate, 4.6 per cent; calcium, 0.1 per cent. Protein, fat and vitamin contents are also satisfactory and this milk is quite palatable and compares favourably with cow's milk. The nutritive value of this milk protein, its supplementary effect to a poor rice diet and the availablity of calcium, phosphorus and B-vitamins have been studied. Results of these experiments indicate that from the nutritive point of view the vegetable milk can be favourably compared with those of cow's milk.

34. Effect of germination on the biological value of proteins of pulses.

H. P. Chattopadhyay and S. Banerjee, Calcutta.

The biological value of the proteins of both germinated and ungerminated mung (*phaseolus radiatus*), kalai (*phaseolus mungo*) and gram (*cicer arietinum*) have been studied by the numerical method of Osborne, Mendel and Ferry. The gain in weight per gm. of protein ingested at 15 per cent level intake of protein has been taken as the measure of the biological value. Young albino rats of 40-50 gm. weight were fed different diets, which were exactly similar except that the pulses were different, for eight weeks.. The control group of rats received casein at 15 per cent level in place of pulses. From the results it was found that the biological value of the proteins of kalai (*phaseolus mungo*) and gram (*cicer arietinum*) were 1.22 and 1.36 respectively. After germination for 48 hours the biological value of these two pulses increased to 1.37 and 1.65 respectively. In case of mung (*phaseolus radiatus*), however, it was found that the biological value of the raw beans was 1.52 and after germination for 48 hours the value decreased to 1.35.

35. Investigations on the nutritional level of the students and nurses of Assam Medical College.

B. Banerjee, Assam Medical College, Dibrugarh.

In order to find out the nutritional level of the middle class young adults of Assam the actual food value of different food-stuffs consumed by the male and female students and by female nurses were calculated. As far as the winter diet was concerned it was found that the male and female students received requisite quota of calories, carbohydrates, fats, proteins, vitamins and iron at an expenditure of rupees fifty five (Rs. 55|-) per capita per month. The nurses received a low diet and their monthly expenditure was only rupees thirty (Rs. 30|-) per capita.

36. Detection of hydorcyanic acid in decomposed Viscera.

S. K. Chatterji and H. D. Ganguly, Calcutta.

Detection of hydrocyanic acid in a decomposed viscera under ordinary distillation process is a difficult problem.

Combining with the sulphur of the organic tissue proteins the acid is converted into thiocyanic acid its salts. It is not possible to obtain hydrocyanic acid from thiocyanic acid by simple distillation with an acid, special oxidising process has been devised by means of which hydrocyanic acid may be detected in the decomposed viscera both qualitatively and quantitatively.

Experiments were undertaken with two to five years old retained samples of viscera which were sent to this Department for detection of poisons and which were found to be highly decomposed. In selection of those cases attention was paid in taking up some known HCN poison cases and some cases where death took place from some other means.

By ordinary distillation process no HCN could be detected in any of them. By the special oxidising process HCN was obtained in those cases having a history of HCN poison. A quantitative estimation was also possible.

The converson of HCN into thiocyanic acid is not quantitative—this has been proved.

In medicolegal work, it is advisable to look for HCN by this special oxidising process where the ordinary distillation process fails.

37. Selenium Content of Kosi Water.

SIULI RUDRA and M. N. RUDRA, Laheriasarai.

Kosi water has been found to contain as much as 1.29 mg of selenium per 100 c.c. during the monsoon. In the dry season the Se content is 70-188 mg. per 100 c.c. The possible danger of using Kosi water for irrigational purposes has been discussed and Government have been urged to review the Dam construction for needed modifications.

38. Normal values of some Chemical Constituents of Buffaloe Blood.

J. S. RAWAT, G. S. LAL and A. ROY, Mathura.

The normal values of a few important chemical constituents of blood obtained from buffaloe calves, (age, 6-8 months), of both sexes, are reported here. The values obtained are as follows :—

Calcium, 9.8 mg./100 ml., serum; Inorganic Phosphorous, 4.4 mg./100 ml., serum; Sugar, 81 mg./100 ml., blood; Chloride, 507 mg./100 ml., blood; Chloride, 571 mg./100 ml., Plasma; Chloride, 388 mg./100 ml., R.B.C.

39. Feeding Soyabean emulsion as a partial substitute for whole milk in raising dairy calves.

S. C. RAY, Bangalore.

Calf raising, specially during the first three months of calf's life is a special problem for Indian dairying owing to comparatively low milk production even in dams which are considered high-yielders according to the Indian standard. If the commonly recommended feeding schedule for the first three months (*i.e.,* 1 lb. of milk for every 10 lb. live-weight of calf) is followed, the total quantity of whole milk required for calf raising works out to be an average of 500 lb. per calf. Since the average lactational yield of so-called high producers (which must not be confused for few hundred of highly-bred pedigreed cattle kept in Government and Institutional farms) would be about 1,200 lb., earmarking over 40% of tde lactational yield for calf feeding will not obviously allow dairying to be a commercial proposition. An investigation was, therefore, carried out to study the effect produced on the growth rate and metabolism of young calves when 50% of the scheduled requirement of whole milk was substituted by a soya-bean emulsion which more or less approximated the composition of cow milk. The results showed that i) calves could be induced to take easily to a diet constituted of a mixture of whole milk and soya-bean emulsion in the proportion of half and half, ii) the average growth rate under such substituted dietary compared well with that obtained by feeding solely on whole milk and iii) the digestibility co-efficient of the substituted diet was slightly lower than the whole milk diet, but the overall retention of nitrogen, calcium and phosphorus was comparable.

40. The iron requirement of sheep.

N. D. KEHAR and V. N. MURTY, Izatnagar.

The quantitative requirement of iron for sheep have been evaluated from simultaneous study of the relation between iron intake and retention, and also the minimum amount of iron required to maintain a good hœmoglobin and serum iron level, on four groups of animals fed on four different levels of iron.

The metabolic data would lead to the conclusion that the minimum iron requirement of sheep is 122.5 mg. of total iron or 50.5 mg. of available iron.

The results on statistical analysis had shown a highly significant direct relation between the intake of total or available iron and its retention, the latter being more significant. The regression equations are,

$$Y = 0.5215\,X_1 - 60.16 \text{ and}$$

$$Y = 0.6872\,X_1 - 34.91, \text{ where } X_2 \text{ and } X_2$$

are the intake of total and available iron respectively and Y, the retention of iron. The minimum daily requirements according to the equation are 115.4 mg. of total iron or 50.8 mg. of available iron per day. Since the available iron is more important from the nutritional point of view, and the close agreement between the metabolic and statistical analysis. the minimum daily requirement of available iron for sheep is 50.65 mg. Expressed in terms of total digestible nutrient the requirement of available iron is 12.3 mg. per cent, or 28.7 mg. of total iron. In terms of body weight it is 81 mg. of available iron or 188 mg. of total iron per 100 lbs.

The relation of intake of total and available iron and also of retention with the serum iron have been worked out statistically.

41. Effect of administration of Gonadotropic Hormones on Semen quality.

S. N. Luktuke, S. Guha and P. Bhattacharya, Izatnagar.

Quality of semen deteriorates during autumn when the atmospheric temperature and humidity are high. An investigation is, therefore, undertaken to find out if semen quality could be improved by treating animals with gonadotrophic hormones during this period. Ten rams were divided into two equal groups on the basis of their semen production during the pre-treatment period. Each of the animal in the experimental group received three subcutaneous injections of 400 I.U. of Pregnant Mare serum Gonadotrophin (PMS) at an interval of two weeks during the period under experimentation. Two ejaculates were obtained weekly from each animal in quick succession on the same day. The semen samples from both the groups of animals were examined for the following attributes :—

(i) Volume (ii) Sperm concentration/ml. (iii) Total spermatozoa/ejeculate (iv) Percentage of abnormal spermatozoa (v) Initial fructose content, and (vi) Fructolysis.

It was observed that the quality of semen obtained from the experimental animals was of a far superior quality than that obtained from the untreated ones.

42. Studies on reducing substances of Semen : Fructolysis in Bull Semen and relation of Sperm concentration to Fructose content, Semen volume and fructolysis.

S. N. Luktuke and P. Bhattacharya, Izatnagar, U. P.

Seven Hill bulls and five Hariana bulls were taken for this investigation. Seven semen samples were obtained from each of these animals, at weekly intervals. In all, 119 semen samples were analysed. The results show that there is significant co-relation between sperm concentration/unit volume and fructolysis as has been found in ram, goat and buffalo bull. Fructose concentration in semen has been found to be inversely related to sperm concentration.

43. Effect of the Intra Vaginal Administration of the Gel Mass of Rabbit Semen on the Reproductive organs of the Female Rabbit.

D. P. Mukherjee, M. P. Johari and P. Bhattacharyya, Izatnagar.

In a previous paper the authors have shown that the gel mass of rabbit semen contains oestrogenic substance. In the present paper it has been shown that the intravaginal administration of the gel mass causes hypertrophy and hyperaemic conditions of the uteri of the immature and ovariectomised adult rabbits. Administration of the gel mass increased the relative weight of the ovaries and size of the follicles in the immature rabbits. The probable function of the oestrogenic substance of the gel mass in normal mating has also been explained.

44. Seasonal Variation in the Rate of Respiration, Pulse Rate and Body Temperature of different age groups of Hariana Cattle.

D. P. Mukherjee, S. S. Jawa and P. Bhattacharya, Izatnagar.

Seasonal variation in the rate of respiration, pulse rate and body temperature of 3 months, 6 months, 1 year, 1½ years, 2 years and 3 years and above age groups of Hariana cattle in four seasons, namely summer, monsoon, winter and spring have been studied.

Statistical analysis of data obtained in this experiment revealed that the rate of respiration, pulse rate and body temperature varied highly significantly between seasons and between groups. In summer and monsoon the rate of respiration, pulse rate and body temperature of the animals were significantly more than in winter and spring. The analysis also revealed that among the age groups, the lower age groups of animals had higher rate of respiration, pulse rate and body temperature. There was also significant variation betweeen the sexes as regard the pulse rate. The male showed higher pulse rate than the female.

45. Haematological Normals of Buffaloes.

H. P. Kapoor, C. M. Singh and A. Roy, Mathura.

The buffaloes occupy a conspicuous position as milch and draft cattle in India. The present invesigation was undertaken to find out the following haematological normals and was carried out during the months of March—May, 1951. Sixteen animals, (8 male and 8 female), ages ranging between six to eight months, were used.

R. B. C. (million per cubic m.m.), 8.6 ; Haemoglobin (gms. per 100 c.c.), 9.1 ; Cell volume, 27.7; Total W.B.C. (per cu. m.m.), 9878; Lymphocytes, 60.0% of W.B.C.; Monocytes, 7.0% of W.B.C.; Neutrophils, 22.4% of W.B.C.; Basophils, 0.34% of W B.C.; Eosinophils, 3.6% of W.B.C.; Specific gravity, 1.048 ; Sedimentation rate, 5.4 m.m. per hour ; Mean Corpuscular volume 32 c μ ; Average corpuscular Haemoglobin, 10.5μ ; Mean corpuscular Haemoglobin concentration, 36.45%.

46. Blood studies in lambs on different levels of protein intake.

N. D. Kehar, P. C. Sawhney and A. N. Bahl, Izatnagar.

The physiological constituents of blood under normal conditions in lambs immeediately after weaning (2-3 months) up to 1 year of age were studied.

Two to three months old lambs were selected and divided into three groups viz., 0.05, 0.04 and 0.03 lb. digestible crude protein per 10 lb. live weight. The animals in the various groups were examined every month for red blood cell, white blood cell, cell volume, haemoglobin, differential count, serum calcium, inorganic phosphorus, magnesium and total protein. No difference was observed under different levels of protein intake up to 4 months of age. At the age of 4-5 months, after being 2 months on the experimental diet, the 0.05 lb. digestible crude protein group gave values for R.B.C. 12.69, W.B.C. 13.1, Cell Volume 38, Haemoglobin 11.41 which are higher than in any of the other two groups. Half the number of animals in each of the above groups were now put on to 0.07, 0.06 and 0.05 lb. digestible crude protein respectively. Similar trends were maintained even after sub-division.

The animals in the 0.07 and 0.06 lb. digestible crude protein groups did not show improvement over the 0.05 lb. digestible crude protein group. The average highest value of 12.98 millions per c.c.m. of R.B.C. was recorded in the 0.05 lb. digestible crude protein group.

47. Energy metabolism in cattle.

D. N. Mullick and N. D. Kehar, Indian Veterinary Research Institute, Izatnagar.

Investigations were carried out to determine the caloric requirement and total digestible nutrients of animals by indirect calorimetry.

Heat production or resting metabolism was studied on 32 adult hill steers of 250 to 400 lbs. of body weight. All the collections were made in the morning after 16-18 hours of feeding. The expired gas was collected and analysed for CO_2, O_2, and CH_4. The heat production for 24 hours was calculated from the analysis of gases and respiratory quotient. The resting metabolism per unit surface area was computed from the following equation :—

$$\text{Surface area} = 0.15 \text{ (wt. in kg.)}^{0.557}$$

The TDN was calculated on the assumption that 1 lb. TDN is equivalent to 1814 calories.

It was found that all the values were 18-20% lower than foreign workers.

48. Studies on protein, calcium and phosphorus metabolism in growing lambs.

N. D. Kehar, P. C. Sawhney and A. N. Bahl, Izatnagar.

The protein requirement of growing lambs, was studied with two to three months' old lambs which were divided into three groups containing different levels of digestible crude protein namely 0.05 lb., 0.04 lb., and 0.03 lb. live weight.

Balance studies were made at six weekly intervals.

At the age of 3 months, the retention of nitrogen, calcium and phosphorus was slightly better in the 0.05 lb. digestible crude protein level than in the 0.04 and 0.03 lb. digestible crude protein levels.

At the age of 5 months, the average retention showed marked improvement in the 0.05 lb. digestible crude protein group, while in 0.03 lb. digestible crude protein group, the retention was not only poor for nitrogen and phosphorus but negative for calcium.

At the age of 6½ months, the average retention in 0.05 lb. digestible crude protein group was double than that of 0.03 lb. digestible crude protein group. Half the number of animals in each of 0.05 lb., 0.04 lb., and 0.03 lb. digestible crude protein groups were put on to 0.07 lb., 0.06 lb., and 0.05. lb. respectively.

The group receiving 0.05 lb. digestible crude protein showed good retention.

At the age of 8 months, 9½ months, and 11 months the trends of relation were similar.

Of the various protein levels fed from 0.03 to 0.07 lb. digestible crude protein per 10 lb. live weight, it has been found that the growth is maximum at 0.05 lb. digestible crude protein level.

49. Investigation on the optimum level of fat in the ration of ruminants;

S. N. RAY, K. SAHAI *and* N. D. KEHAR, Izatnagar.

Two sets of experiments were conducted, each containing three groups of three Kumauni bullocks each. The concentrate mixtures in each set were so devised that they were isocaloric ; so that though the mixtures differed in fat contents, the protein and calories offered through the concentrate mixtures were kept constant in the different groups of each set. The roughage in both the sets of experiments consisted essentially of wheat bhoosa fed *ad lib.* During metabolism trials consisting of 10 days for each set, the fat percentages for the six groups on the basis of total dry matter intake 53 were 0.94, 1.72, 3.7 6.32 and 9.7 respectively

It was found that the digestibility of protein and ether extract increased whereas that for nitrogen-free-extract decreased with the increasing fat levels. The urinary nitrogen elimination increased as the fat level went up, so much so that the animals in the highest fat group were in negative nitrogen balance.

In calcium and phosphorus balances, there was a progressive deterioration as fat levels were increased.

The statistical analysis revealed that the most efficient digestible nutrients intake its adult bullocks takes place when the fat level is 3.4%.

50. Investigations on silage making—Lucerne and Paddy straw silage as feed for cattle.

N. D. KEHAR and I. KUMAR, Izatnagar.

In continuation of previous studies on ensilage from these laboratories, observations on attempts to improve the palatability and nutritive value of paddy straw were undertaken. Paddy straw was ensiled with lucerne in the proportion of 2:3 on dry matter basis.

The original crop mixture on analysis was found to contain 16.52% Crude protein, 1.47% Ether Extracts, 31.59% Crude fibre, 37.33% Nitrogen free extract, 1.33% Lime (Cao), 0.61% Phosphates (P_2O_5), 0.16% sodium (Na_2O), 3.32% potassium K_2O), and 1.40% 'Oxalic acid.

The silage on analysis was found to contain 14.31% crude protein, 1.05% Ether extract, 37.28% Crude fibre, 28.07% Nitrogen free extract, 1.68% Lime (Cao), 0.58% Phosphates P_2O_5), 0.11% Sodium (Na_2O), 3.72% Potassium (K_2o), and 1.32% Ovalic acid.

To study the palatability and nutritive value of the silage, it was fed to bullocks. The dry matter consumption per 100 lbs. live-weight per day was found to be 756 gms. which is indicative of fair palatability. The average digestion coefficients for Crude protein, Ether extract, Crude fibre and Nitrogen free extracts were found to be 62.38, 38.83, 61.09 and 48.77 respectively. The digestible Crude protein, total digestible nutrients, and Starch equivalent values per 100 lbs of silage on dry basis were 8.93, 46.31 and 24.01 respectively. All the animals were in positive balance with respect to Nitrogen, Calcium and Phosphorous, presented a healthy appearance and showed an average increase of 8 lbs. in live weight during the experimental feeding period.

It will be seen that ensiling paddy straw with lucerne had yielded a fodder of high nutritive value and the deleterious effects of paddy straw feeding have been considerably reduced.

51. Investigations on subsidiary Feeds : Mangrove (*Avicennia officinalis* Linn.) leaves as feed for cattle.

N. D. Kehar and S. S. Negi, Izatnagar.

Mangrove, commonly known as *cher* in Kutch, is a small plant growing abundantly on the sea side. It does not constitute a normal fodder but in times of famine animals are forced to eat its leaves.

In order to find out whether *cher* leaves can form a suitable roughage, observations were made on its palatability, chemical cmposition and nutritive value.

On chemical analysis the leaves were found to have the following percentage composition on dry basis : total ash 18.17, crude protein 12.26, ether extract 0.93, crude fibre 11.94, nitrogen free-extract 56.70, CaO 0.79, P_2O_5 0.39, MgO 1.39, Na_2O 6.05, K_2O 1.48 and chlorine 5.14. The leaves are rich in crude protein, lime and phosphate. They aslo sow an excess of soda and chlorine which may probably be due to the fact that in their normal habitat, they are frequently washed by the sea waves.

The leaves as such were not palatable to animals and as a single feed could form only half the dry matter requirements. Hence these were fed with wheat *bhoosa* mixed in equal proportions. A little quantity of rape cake was included in the ration to meet the digestible protein requirement. Since the leaves were rich in soda and chlorine, no common salt supplement was given.

In the metabolic trial conducted on Kumauni bulls with a ration computed as above, the average percentage digestibilities of crude protein, ether extract, crude fibre and nitrogen-free-extract in *cher leves* were found to be 51, 29, 21 and 52 respectively. The D. C. P., T. D. N. and S. E. values in lb. per 100 lb. of dry leaves were calculated to be 6.25, 38.85 and 32.90 respectively.

Thee above observations show that in times of scarcity *cher* leaves would make available a fairly large amount of green fodder for livestock along the sea coast.

52. Studies on Graminae crops.

N. D. Kehar and V. N. Murty, Izatnagar.

The effect of progressive maturity and irrigation on the iron content of oat, barley, and wheat were studied. The samples were collected from the irrigated and non-irrigated crops for five months at monthly intervals from the date of showing till they were dead ripe. The samples were analysed for dry matter, crude protein, iron, calcium, phosphorus, copper and ascorbic acid.

The iron content was minimum at the end of second month in wheat and barley and at the end of third month in oat. The iron content was maximum at the end of the first month in all the crops. Copper, in all the crops, exhibited a decrease from the second month of growth. The dry matter increased while the crude protein, calcium, phosphrous and ascorbic acid decreased with the progressive maturity of the crops.

The iron content was affected both by irrigation and progressive maturity.

53. Iron content of animal feeds.

N. D. Kehar and V. N. Murty, Izatnagar.

In view of the paucity of information on the distribution of iron in animal feeds the iron content of 151 samples from different categories of animal feeds has been analysed by the dipyridyl method,. The average iron content in mg. per 100 gm. of dry material of the different animal feeds are as follows :—fish meals, 68.27 (46.71—84.59) oil cakes 49.43 (12.89—72..44) green forage 43.21 (26.29—98..40) dry roughages 41.21 20.29—57.96), cereal bye-product 20.94 (13.13—29.12)and the cereals, grains and seeds 7.68 (3.96—13.68).

The physiological and genetical factors of the plant, the environmental factors together with the soil conditions and the manufacturing process in the case of bye-products would influence the iron content of animal feeds.

54. Studies on tree leves as fodder.

VI. Peepal (*Ficus religiosa*) leaves as cattle fodder.

W. Hussain, B. Sahai and N. D. Kehar, Izatnagar.

Investigations were carried out to determine the palatability and nutritive value of peepal leaves as feed for cattle.

On chemical analysis, the green leaves were found to contain, 9.66 per cent protein, 26.96 per cent crude fibre, 2.66 per cent ether extract, 45.82 per cent nitrogen free extract, 5.77 per cent calcium (CaO), 0.496 per cent phosphorus (P_2O_5).

Feeding experiments on cattle with leaves as the sole feed indicated that the feed was quite palatable and the consumption was quite normal. The digestion coefficients on an average for crude protein, ether extract, crude fibre and nitrogen free extract were found to be 56.6, 23.0, 29.3 and 53.4 respectively.

The digestible nutrients in lbs. available per 100 lbs. of leaves on dry basis are calculated to be : digestible crude protein 5.47, total digestible nutrients 30.22, and starch equivalent 23.04.

The animals were in positive balance with respects to nitrogen, calcium and phosphorus.

The fore-going observations indicate that peepal leaves can form a maintenance ration for cattle and as such may well be utilised as an alternative sources of fodder.

55. Studies on tree leves as fodder.

ViII. Peepal (*Ficus religiosa*) leaves as fodder for gaoats.

W. Hussain, B. Sahai and N. D. Kehar, Izatnagar.

The nutritive value of Peepal leaves as fodder for goats was investigated.

The chemical composition of green leaves on dry matter basis was found to be : crude protein 9.48 per cent, ether extract 2.63 per cent, crude fire 24.47 per cent, nitrogen free extract 45.80 per cent, calcium (CaO) 4.97 per cent, phosphorus P_2O_5) 0.04 per cent.

Feeding experiments were carried on five adult male goats with leaves constitut-

Digestion coefficients on an average were shown to be :—crude protein 54.5, crude fibre 39.5, ether extract 26.2, and nitrogen free extract 59.8.

The nutritive value of the leaves was found to be : Digestible crude protein 5.17 lbs., total digestible nutrients 43.78 lbs., and starch equivalent 29.04 lbs., per 100 lbs. of leaves on dry basis.

The animals were in positive balance as regards nitrogen, calcium and phosphorus.

The above observations serve to point out that peepal leaves can, by themselves, form a satisfactory ration for goats.

56. Studies on tree leaves as fodder. VIII. Bargad (*Ficus bengalensis*) leves as cattle fooder.

W. HUSSAIN, B. SAHAI and N. D. KEHAR, Izatnagar.

On chemical green Bargad leaves were fiund to contain 9.63 per cent crude protein, 2.64 per cent ether extract, 26.84 per cent crude fibre, 51.59 per cent nitrogen-free extract, 2.53 per cent calcium (CaO), 0.403 per cent phosphorus (P 'O).

Feeding experiments with leaves, as the sole feed, indicated that leaves cannot form a maintenance ration for cattle as evidence by low matter consumption, loss in body weights, and negative balances for nitrogen and phosphorus. However, it was observed that in a composite balanced ration leaves could be fed upto 40 per cent of the dry matter requirement without any adverse effect on the health of the animals.

The nutritive value of Bargad leaves when fed as sole feed was calculated to be digestible crude protein 1.99 lbs., total digestible nutrients 44.53 lbs., and starch equivalent 28.61 lbs. per 100 lbs. of leaves on dry basis.

The above observations point out that Bargad leaves may be utilized as part roughage, for feeding cattle during periods of fodder shortage.

57. Studies on tree leaves as fodder.
IX. Bargad (*Ficus bengalensis*) leaves as fodder for goats.

W. HUSSAIN, B. SAHAI and N. D. KEHAR, Izatnagar.

Investigations on the palatability and nutritive value of Bargad leaves as fodder for goats were carried out.

The percentage chemical composition of the leaves on dry basis during the feeeding priod was found to be : crude protein 9.63, ether extract 2.64, crude fibre 26.84, nitrogen free extract 51.59 calcium (CaO) 2.53 and phosphorus (P_2O_5) 0.403.

For conducting the feeding trials four healthy male goats were selected and fed green Bargad leaves along with tender twigs. The leaves were found to be palatable and dry matter consumption met the requirements.

The average digestibility coefficients for crude protein, ether extract, crude fibre and nitrogen free extract were found to be 42.5, 31.8, 41.8 and 65.7 respectively.

The nutritive value was shown to be : digestible crude protein 4.09 lbs., total digestible nutrients 51.05 lbs and starch equivalent 35.0 lbs per 100 lbs., of dry matter.

The animals were in positive balance with respect to nitrogen, calcium and phosphorus.

The above observations point out the Bargad leaves may constitute a suitable maintenance fodder for goats.

58. Studies on the Ascorbic Oxidase Activity of some Common Indian Pulses during germination.

HARIPADA CHATTOPADHYAY and SACHCHIDANANDA BANERJEE, Calcutta

The ascorbic acid oxidase activity of fiive varieties of common Indian pulses *viz.*, *Phascolus Radiatus*, *Phascolus Mungo*, *Cicer Arietinum*, *Pisum Sativum* and *Lens Esculenta* during germination has been studied. The ascorbic acid activity of the pulses starts after about 24 hours of germination and then increases gradually thereafter until it reaches the maximum limit after about 72 hours of germination, which is then retained. This activity is more or less similar in all the varitics, but is slightly more pronounced in the *Phascolus Mungo* and *Cicer Arietinum* than in the other three varieties. The utility and significance of this activity in the seedlings during germination have been discussed.

59. Nutritive value of Vegetable Proteins in relation to Liver Protein Maintenance.

M. R. SAHASRABUDHE and M. V. LAKSHMINARAYAN RAO, Mysore.

The more important cereal and pulse proteins have been assayed with respect to the regeneration and maintenance of liver protein in the rat.

At a dietary level of 10 per cent the efficiency of the proteins for the maintenance of liver ppotein levels decreases in the following order : Casein, Rice, Ragi, Wheat, Jowar, Bengal-gram, Tugar gram,—Groundnut, Greengram and Blackgram. Quantitatively the nutritive values of the proteins assessed by this method show, with a few exceptions, general correspondence with those determined by the classical rat growth and nitrogen balance methods. The liver protein levels are appreciable enhanced on the supplementation of methionine to pulse proteins known to be deficient in this amino acid. A correlation between the methionine content of the proteins and their ability to maintain liver protein—levels is suggested.

60. Effect of Vitamin B12 on the Synthesis of Protein and Nucleic Acids in the ~~Protein~~. LIVER

M. R. SAHASRABUDHE and M. V. LAKSHMINARAYANA RAO, Mysore.

Vitamin B12 was found to stimulate the regeneration of liver protein as well as nucleic acids (both DNA and RNA) in the fasted rat.

61. Comparative study of various fat Suppliments to the low protein diets in relation to growth and Liver Fat Deposition.

62|a

M. R. SAHASRABUDHE and M. V. LAKSHMINARAYANA RAO, Mysore.

Influence of groundnut oil, cocoanut oil, ghee and hydrogenated groundnut oil at dietary levels of 5, 10 and 30 per cent have been studied. At 30% level in the diet there is considerable deposition of fat in the liver, butter fat causing greater liver fat infiltration than any of the other fats. Growth, irrespective of the nature of the fat is considerably retarded. At the lower levels, fat supplementation induces increased growth without appreciable accumulation of fat in the liver.

1952

62. Optimal Dietary Fat Level in Relation to Grogwth and Tissue-Composition.

M. R. SAHASRABUDHE and M. V. LAKSHMINARAYANA RAO, Mysore.

On low protein diets, a dietary fat level of 10% gives best growth responses while higher levels of fat intake result in an excessive fat deposition in the liver and other body tissues.

Judged from the growth responses alone, increasing the amount of fat, from 6 to 30% in higher protein diets, is beneficial. At 30% fat level in the diet, there is a greater deposition of body fat. However, the increases in body weight with different amount of fat intake are not entirely due to the deposited fat but also to increase in nitrogenous constituents.

There is an inverse relationship between the dietary fat—level and the liver protein content, which is more pronounced at low levels of protein intake.

Hb content and R.B.C. levels are considerably lowered on low-protein-high-fat diets.

✓ 63. Effect of Partial Replacement of Rice or Wheat poor vegetarian Diets by Tuber Flours on the Nutritive Values of the Diets.

(Proc. Ind. Sc
Congr. 1

V. SUBRAHMANYAN, H. B. N. MURTHY and M. SWAMINATHAN, Mysore.

Substitution of rice or wheat by tapioca or sweet potato flour to the exent of 25% in a poor vegetarian diet does not lead to any deterioration in the overall growth promoting value of the diet when fed to albino rats. On the other hand, there is some distinct improvement in the growth response especially as compared with an exclusive rice diet. The average food intake of the animals in the rice plus tapioca diet was 15-25% more than on the exclusive rice diet. but the corresponding increase in growth was of the order of 40-50%. Paired feeding experiments showed that when the food intake is equilised, the average weekly increase in body weight of rats on rice plus tapioca diet was slightly higher than on the exclusive rice diet though the difference is not significant.

Experiments designed to study the supplementary value of minerals present in tapioca to rice diet could only partially explain the increased growth rate in the case of rice plus tapioca group. Results on the metabolism experiments indicate that in the case of rice plus tapioca group *ad lib.* there is an extra retention of one mg. of calcium per rat per day compared to the rice group.

The incorporation of groundnut cake flour together with the tuber flour as a partial substitute for rice or wheat leads to further improvement in the overall nutritive value of the diet.

The nutritive value of rice—tapioca mixed containing increasing proportions of the latter were studied in the case of experimental animals. The results showed that even up to 50% there is no deterioration in the overall growth value (as compared with an exclusive rice diet) provided the diet is fed *ad libitum.* When the proportion of tapioca in the mixture is more than 25%, there is a gradual decline in the overall value. As the two diets produce about the same response under conditions of paired feeding when tapioca forms 25% of the rice, this should be considered to be a fairly safe limit in regard to the admixture of tapioca with rice.

The significance of the above findings, with particular reference to the urgent food needs of the country has been discussed.

64. The effect of partial replacement of rice in poor Rice diet by Tapioca on the Retention of Nitrogen, Calcium and Phosphorus in Human Subjects.

V. Subrahmanyan, H. B. N. Murthy and M. Swaminathan, Mysore.

With a view to obtaining experimental evidence regarding the value of tapioca as a partial substitute for cereals, the metabolism of nitrogen, calcium and phosphorus was studied in adult human beings fed on diets based on rice, and rice plus tapioca respectively. The experimental control rice diet was so constituted as to simulate the average diet of the poor rice eater. In the test diet, 25% of rice was replaced by tapioca flour.

The experiment was conducted on six adult human beings for a period of 12 days. The diets, urine, and faeces were analysed for nitrogen, calcium and phosphorus. The results are summarised below :—

(1) When 25% of rice was replaced by tapioca, the average daily nitrogen intake decreased from 9.7 g. to 8.9 g. because of the lower protein content of tapioca. In spite of this lowering in nitrogen intake, the average retention of nitrogen on the rice plus tapioca diet (2.74 g) was almost equal to that observed on the rice diet (2.64 g.).

(2) The average retention of calcium and phosphorus on the rice plus tapioca diet was greater than that observed on the rice diet.

65. Fortification and Colourisation of Vanaspati with Carotene derived from Vegetable sources.

V. R. Bhalerao and M. Srinivasan, *Mysore.*

In the course of our investigations on the labelling of Vanaspati with a view to detecting it when present in ghee, it appeared possible that colourisation of Vanaspati with crude carotene together with the associated chlorophyl derived from vegetable sources would prove useful. The presence of the pro-vitamin A would add to the nutritive value of Vanaspati. The materials used as sources of carotene were carrots, leaves of *Amaranthus gangeticus*, drumstic and lucerne. Methods of preparing a concentrated extract of carotene from these sources, the incorporation of such concentrate into Vanaspati and the assay of the processed Vanaspati for carotene content are discussed.

Like the other dyes and pigments chlorophyl and carotene can be removed by powerful absorbents, but the presence of the colour would act as a deterrant to gross adulteration, even in rural areas, as is now the case.

66. Investigations on some little known Indigenous Edible Plant Materials II, *Amaranthus paniculatus : the nutritive value of this seed.* as Possible sources of food supplements.

N. Subramanian and *M.* Srinivavasan, Mysore.

It is known that the seeds of this material in its puffed form is consumed in small amount in different parts of the country. Its analysis revealed that it is a rich source of protein and calcium. Animal feeding experiments were therefore undertaken and the results show that the raw or puffed seeds fed in place of rice in rice diet enhances the growth of rats by 3-4 times. Balance studies and growth experiments on rats fed a diet of the raw seed at 10% protein level showed that the nutritive value was comparable to that of casein. Full data and details of experiments are discussed. The possibility that the seed in its puffed is capable of being used as a break-fast food is suggested.

67. Investigations on some little known indigenous Edible Plant Materials as Possible Sources of Food Supplements.

I. *Ageva vera cruz : the nature of its carbohydrates.*

M. Srinivasan, V. R. Bhalerao and N. Subramanian, Mysore.

While doing a survey of little known indigenous sources of *foodstuffs* with potential food value, it came to our notice that the plant *Ageva vera cruz* is one such source. Portions of the plant, it is known, are consumed by the poorer people, especially under conditions of famine. The edible portion that is used is the soft underwood. This was the starting material for our investigation, which has revealed that this plant material consists essentially of polyfructosans of the type of inulin and its isomers. Methods of fractionation using methyl alchol and further characterisation of the different fractions are discussed.

The material has got to be processed by prolonged cooking with tamarind water and jaggery for rendering it edible ; otherwise, the deleterious constituents which it is supposed to contain is said to adversely affect the health. A small amount of resinous principle has been obtained from the material by extraction with ethyl alchol or acetone. The nature of this principle and whether this is the unwanted inedible portion is being investigated.

✓ 68. Biological value of Proteins of synthetic grains from Tapioca and Groundnut Flour.

3

S. Kuppuswamy, G. Rama Rao, Saranya Kumari Reddy and M. Swaminath, Mysore.

1) The biological values of the proteins of synthetic grains prepared from different blends of tapioca flour and groundnut cake flour were compared with those of rice and wheat proteins at various levels of intake by the following four methds (a) Nitrogen balance method (b) Rat-Growth Method, (c) method based on liver protein regeneration (d) method based on haemopoiesis. 2) Nitrogen balance experiments showed that at 5% level of intake, the biological value of synthetic grain proteins is definitely inferior to that of rice proteins and slightly inferior to that of wheat—proteins, while at a 10% level of intake, the biological values of rice and wheat proteins are nearly of the same order. 3) Rat-growth experiments broadly bore out the above results and showed that the protein efficiency ratios of synthetic grain and wheat (both at 75% and 10% levels of protein intake) were nearly equal ~~similar~~. 4) Synthetic grain and wheat proteins were found to be almost equally effective for the regeneration of liver proteins in fasted rats [but they were inferior to casein in this respect.] 5) At 5% level of intake, the biological value of synthetic grain proteins for haemopoiesis was slightly less than that of rice proteins while at a 10% level of intake, synthetic grain proteins were nearly the same ~~as efficient~~ as that of wheat proteins in promoting haemopoiesis in anaemic rats.

✓ 69. Amylases of of Ragi and Ragi Malt.

M. R. Chandrasekhara, M. Swaminathan and V. Subrahmanyan, Mysore.

Ragi unlike barley, wheat etc., has been shown to contain very little, or no amylase in the ungerminated state. On germination however, both alpha and beta amylases develop rapidly. This increase in amlyses has been shown to continue till 96 hours after germination, after which period there is slightly reduction. Ragi malt has been shown to contain both alpha and beta amylases in about equal proportion. By Ohlsson's teachnique of differential inactivation the optimum pH and temparature for both alpha and beta amylases have been determined. It has also been shown that neutral salts do not influence the activity. Malts prepared under identical conditions from four different varieties of ragi have been compared for a regular activity.

70. Seasonal Periodicity in the Grounds of the Common Indian Catfish Heteropeustes Fossilis (Bloch).

AMIYA B. KAR and ASOK GHOSH, Calcutta.

An attempt has been made in this study to investigate the seasonal periodicity in the common Indian catfish, Heteropneustes fossilis (Bloch). The males of this species do not exhibit any seasonal change in the testicular activity. The production of spermatozoa goes on throughout the year. The females, however, show a spectacular ovarian periodicity. In course of its annual cycle the female gonad passes through three distinct phases—*the preparatory phase, the active phase* and *the quiescent phase.* The changes which take place in the ovary during these phases have been described in detail. An effort has also been made to explore the possible endocrinological mechanism responsible for the ovarian periodicity.

71. Redox Potential of Alloxan and its Physiological Action.

P. SEN and G. BHATTACHARYA, Calcutta.

The effect of the administration of a large number of redox compounds, placed both above and below alloxan in the redox scale, on the blood sugar level of rats and rabbits have been studied. The effects of the same compounds on the production of diabetes by alloxan in rats have also been studied. It has been observed that compounds placed above alloxan in the redox scale have no effect on the blood sugar level of the animals. Thionine, a compound which possesses an E'. value almost equal to that of alloxan produced an initial hyperglycemia and a subsequent hypoglycemia just like alloxan, but could not produce any diabetes. All of the compounds placed below alloxan in the scale produced an initial hyperglycemia but produced neither the secondary hypoglycemia nor the final diabetic hyperglycemia.

Regarding the effect of the above compounds on the diabetogenic action of alloxan, thionine was found to enhance and toluidin blue and neutral red to prevent it.

It is suggested that the initial alloxan hyperglycemia is a general effect of the reducing power of alloxan, while the secondary hypoglycemia is critically dependent on an E_o' value of $+\cdot 06$ volt or near about it. It is further suggested that the redox potential of alloxan is probably one of the determining factors, although not the only one, for its diabetogenic action. The preventions obtained are possibly due to inactivation of alloxan by the previously administered dyes before alloxan could exert its specific diabetogenic effect.

72. Reversal of the Diabetogenic Action of Alloxan by Sulfhydryl Compound.

P. B. SEN and G. BHATTACHARYA

Subcutaneous injection of 175 mg. per kilo dose of alloxan in young rats (wt.-100 gm. each app.) previously fasted for 24 hours, produced diabetes in all of the animals. When, however, the injection of alloxan was followed by repeated administration of sulfhydryl compounds, such as, BAL (2:3-dimercaptopropanal) and cysteine, a large per centage of the rats failed to develop diabetes. The degree of protection from diabetes depended upon the interval between the injection of alloxan and the beginning of treatment with the sulfhydryl compounds, the total amount of the sulfhydryl compounds used and the rate at which they were administered. Doses of BAL and cysteine, equivalent to each other in their SH content, offered practically the same degree of protection. The results obtained indicate that the prevention obtained is essentially due to a reversal of the fundamental action of alloxan, responsible for the necrosis of the beta cells. The fundamental action seems to consist of inactivation of some essential sulfhydryl enzyme (s) of the beta cells due to oxidation of the SH groups to the -S-S- stage and beyond by the administered alloxan.

73. A new method for the estimation of Nicotinic Acid in Biological Materials.

D. K. CHAUDHURI, University College of Science & Technology, Calcutta.

A new colorimetric method for the estimation of nicotinic acid using p-aminobenzoic acid as coupling reagent has been developed. The specificity of this reagent has been tested in regard to several chemical substances; of these, only nicotine and pyridine have been found to interfere. Interference due to pyridine could be eliminted during the procss of extraction. The nicotinic acid contents of several biological materials have been estimated by this method and compared with those obtained by the method of Wang and Kodicek (Biochem. J-37,530; 1943). This method has been slightly modified to estimate nicotinic acid in milk.

SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCE

PRESIDENT—PROF. PARS RAM.

TEACHING AIDS & THE TEACHING OF PSYCHOLOGY.

1. A Tachistoscope for paired comparisons.

S. JALOTA, Benares.

The tachistoscope described here has been invented by the author for experiments on perception and aesthetics involving comparison of two visual stimulii. Such experiments mainly lie in the field of Perception and the field of Experimental Aesthetics.

This apparatus is specially devised for longer exposures (of 1″ to 5″), and can be used with paired figures, each occupying a maximum area of 4″ × 4″ (the two together occupying 4″ × 8″ of space). Special cards of 4¾″ sq. size are used for stimulus figures. Illumination from mains (or dry cell batteries) is provided to meet conditions of defective visibility. The experimenter can expose his materials by the quarter turn of a handy knob. On release, the outer screen falls with its own weight. The stimulus cards can be taken out and replaced with ease, speed and economy, without disturbing the subject. Arrangement is also made for a pre-exposure convergence of the eyes of the subject on the centre of the exposure field.

The apparatus is in use at the Laboratory of Experimental Psychology, Benares Hindu University.

2. Basic preparation for an Honours Course in Psychology.

B. KUPPUSWAMI, Madras.

Various Universities in India have different standards for admitting students for Honours courses in Psychology. A careful selection of students with the necessary previous equipment will enable them to undergo the course with profit and engage themselves in research after finishing the college career.

The paper shows that training in Physics, Zoology, Physiology, Statistics, Sociology and Anthropology, is basic for a serious study of behaviour problems. It is true that we cannot expect any student to have training in all these branches at the Intermediate level. It is best to have these requirements in view while making selection for admission. In order to see that this basic equipment is ensured the paper suggests that the co-operation of the other departments ought to be sought by the Psychology Department so that in each of the above subjects a short course of lectures and intensive laboratory and field work training is made available to the students selected for Honours course. Aversion to deal with things and numbers can hardly serve as a basis for scientific study of behaviour today. Students with such aversions should be advised to promptly give up the course.

THEORY OF PSYCHOLOGY

3. Psychic Bisexuality of Rabindra Nath Tagore.

K. M. RAY CHOWDHURY, Aligarh.

A careful analysis of Shesher Kabita has been attempted in this paper. Psychic Bisexuality of Rabindra Nath Tagore has been commented upon.

4. The Unconscious in Sri Aurobindo.

INDRA SEN, Pondicherry.

To Shri Aurobindo the individual is an evolutionally growing factor and therefore the conscious and the unconscious are dynamic in character and on the whole directed towards goals of progressive organisation. The unconscious—or rather the inconscient, as he calls it, since it is not the contradictory of consciousness, but where consciousness is not yet evolved—is to him the general substartum out of which only a fragment has managed to become conscious. And "the subconscient is the inconscient in the process of becoming conscious ! But wheras to Western Psychology all that is not conscious becomes unconscious, to Sri Aurobindo the inconscient and subconscient constitute only the evolutional past of personality. The evolutional future too is a present potentiality and constitutes a distinct aspect, in fact the more relevant aspect for the understanding teleological trend of our mental life. This he calls the Superconscient and regards it correlative to the subconscient, in the sense that to grow into the superconscient is the most effective way of growing out of the sub and the inconscient or becoming conscious of them.

Now so far as the inconscient and the subconscient are concerned Sri Aurobindo distinguishes three ranges of them. These pertain to the three principal factors of our personality, the physical, the vital and the mental. Ordinarily we identify consciousness and mental awareness. But says Sri Aurobindo that "if we separate the mind as witness —we can discover that life and body have a consciousness of their own". This is no doubt a submental consciousness. Now the subconscient is below the conscious in the mind, in the vital and in the physical. It is the home of "old habits, impulses, dormant or suppressed, rejected elements of the nature,—returning them constantly but often chaotically to the surface consciousness." The inconscient is the yet lower substratum of personality and in the main constitutes the mechanical necessities of our nature and its inertia.

To the author, this view of the unconscious and the subconscious is capable of explaining the widest range of facts of the normal and the abnormal behaviour of human personality as also bringing them into line with the facts of general evolution. Besides, through the correlative fact of the Superconscient, it is able to offer the most effective way for the organisation and integration of the subconscious. The cultural consequences of Shri Aurobindo's concept too will evidently be the more balanced and harmonious.

5. Some Indian Dream Theories.

KRISHNA SEN, Berhampur

The paper presents the theories of dream given in the ancient Indian literature. A comparative study of Indian and Western views has been attempted, and the basic similarity of the two has been elaborated.

EXPERIMENTAL PSYCHOLOGY

6. Colour vision and colour preference.

K. RAY CHOWDHURY, Aligarh.

Twenty-four College students (age range 14-30) were asked to report (1) the duration of negative after-image for primary colours (2) the colour that dominated most when one of their eyes was stimulated by one colour and the other by its antagonistic colour, (3) the colour they preferred when the two antagonistic colours had been presented to them in pairs.

It was found that the negative after-images of those colours which had not been preferred for their feeling tone and aesthetic value were experienced for a much longer time than the negative after images of colours preferred by them. The colour preferred also dominated over its antagonistic colour when the complementary pair were stereoscopically presented. These experiments reveal an organic connection between sensation and feeling tone of colours and suggest that an explanation of the simultaneous colour constrast phenomena must be sought in the integral nature of feeling and sensation rather than in the "unconscious influence" as suggested by Helmholtz. These results compel a revision of the equilibrium hypothesis of Hering.

7. An experimental study of Telepathy and Clairvoyance.

M. A. Hafeeu, Mysore.

The paper reports the incidence of the Extra Sensory Perception (Clairvoyance and Telepathy) in a group of Junior B.A. students and attempts to find the relationship between them. Further, in Part II an attempt is made to find out the relationship between the capacity for clairvoyance and telepathy and emotional (in) stability as measured by Woodworth's Psychoneurotic Inventory.

8. Influence of the Group upon Mental work.

Anandi Hazeri, Muzaffarpur.

This investigation was carried out to study

(1) the effect of (a) a co-working Homogenous Group, and (b) of a co-working Heterogeneous Group upon the mental work of individuals and

(2) the difference in the effects between the two kinds of social stimulii.

Twenty College students—ten boys and ten girls—were tested under three different conditions, i.e., (i) working alone, (ii) working with a co-acting homogeneous (having members of the same sex) group, (iii) working with a co-acting heterogeneous having members of both sexes) group.

Two tests were applied—(1) Consonants Cancellation Test, (2) Multiplication Test.

The following conclusions seem to follow:—

In both the tests and in both classes of subjects

(1) The output of work has increased significantly but the quality of the work has remained almost unaffected in the presence of a homogeneous co-working group than while working alone.

(2) The output of work and the percentage of errors have both increased in the presence of a heterogeneous co-working group than in the presence of the homogeneous group. This means that the quality of the work has deteriorated under the influence of the stimuli from a heterogeneous co-working group.

MENTAL TESTING

9. Standardisation of a Group test of general mental ability (in Hindi No. 3-4|51 B.H.U.).

S. K. Daspande, Benares.

This paper describes an attempt to design and standardise a verbal group test in Hindi. It is meant for School-going population (11 to 17 years) and is an Omnibus type test. The subtests comprising the test are:—(1) Similars, (2) Opposites, (3) Number Series, (4) Classification, (5) Best Answer, (6) Inference and (7) Analogies. This is a well-saturated 'g' factor test.

The test was tentatively administered on a population of over 200 boys and girls of Classes VI to XI. Analysis of the Return and item analysis led to certain modifications. The modified version has its items well graded. Their respective difficulties when plotted were almost in a straight line upto the 70th item. The Equation of the straight line best fitting the plotted points was found to be 100 y—273 x : 890. A few questions found to be unsuitable were also discarded. The test scores have been correlations, charts, and graphs showing distributions of scores, ages, and difficulties of items, in the modified varison of the test. Average effect of position in the family on the Test Scores is given in the following table :

Child's position among the siblings	I	II	III	IV	V	VI
Average scores ..	35.9	37.7	42.8	33.6	36.9	36.4
Ns	52	53	32	25	12	8

10. A Study of Cattle's Disposition Test.

M. A. HAFEEZ , Mysore.

There are very few tests for measuring the strength of the dispositions. One of these is Cattell's "Projection" Test of Dispositions. 52 students of the B.A. Classes were given this tets, which covers six dispositions, viz., the assertive, the acquisitive. the gregarious, the timid, curiosity and plaintive, and the results analysed in this paper. The relation between the disposition of curiosity and intelligence is commented upon.

11. Engineering Aptitude Tests.

MAYA GUHA, Calcutta.

An Engineering Aptitude test was devised to test the Jadavpur Engineering College students on the principles on which the O' Rourke and other foreign tests are made. Correlations of intelligence test scores with aptitude tests, university results and interview results have been worked out and commented upon. Correlation between scores on Engineering Aptitude tests and the follow-up records is being worked out.

CLINICAL AND ABNORMAL PSYCHOLOGY

12. New Horizons in Clinical Psychology.

L. C. BANDARI, New Delhi.

This paper deals with some of the foremost developments which have taken place in recent years in the field of Clinical Psychology. It also attempts to discuss the meaning and present day status of this important branch of Psychology, and the vital issues which face clinical Psychologists in a field where their interests clash with those of Psychiatrists. In order to promote further advancement in the methods of diagnosis and teatment in clinical psychology, in view of the urgency of Psychiatric problems in the modern world, emphasis is given to the importance of close collaboration between psychiatrists and clinical psychologists in a task which require their mutual co-operation and goodwill.

Psycho-somatic Medicine has been mentioned as representing the most modern and latest scientific discipline which has developed in the medical world, since world was II. It provides the basic approach in the application of facts of psycho-pathology to a number of so-called functional and organic illnesses.

In the therapy of emotional disorders "Brief Psycho-therapy" has been stated, as a new methodological advance, which seems to provide the benefits of psycho-therapy to the masses. To serve the wider interests of individual and community mental health, the importance of training in the use of techniques of Brief Psychotherapy has been especially stressed upon.

13. Psychology of Schizophrenia.

N. N. CHATTERJI, Calcutta.

Schizophrenia is a psychotic disorder with a variety of symptoms. Patients usually lose all interest in their surroundings and many patients in the course of time become demented. Kraeplane, Mott and other authorities looked for the causes of the disease in the endrocrine disturbances. Freud tried to explain the origin of this disorder by his libido theory. He believed that in these cases libido is usually withdrawn from the outside object to the ego. Why should the libido be withdrawn to the ego in these cases ? There is evidence to believe that the wish to go into the mother's womb is the cause of the withdrawal of the libido. But why should this desire be active in these cases? In the autoerotic stage this wish remains active but in the narcisstic stage it becomes bound up when relation between ego and super-ego would be properly adjusted. In the psychotic cases this adjustment is never optional and it breaks down in the patient's process of facing of difficuties in the reality system. This failure releases the wish to regress to the mother's woumb. An attempt to bind up this wish once more results in schizophrenic symptons.

14. Response psychology and interaction between mind and matter.

SRIMANT LAL DAS, Patna.

Joad in his 'Trends of Modern Thoughts' says "Matter influences mind everywhere; mind influences matter nowhere."

The author has in his possession plenty of evidence to show that mind does influence matter; that the response or reaction of the external world to man's inner mental state, is a fact.

The Law of Compensation is one grand generalisation governing the response of the external world to the inner mental state.

A state of elation is followed by some unexpected incident causing humiliation. A state of perfect security is suddenly disturbed by some unexpected disaster.

The miracles of 'Sharnagati' follow a state of utter helplessness, when you throw yourself entirely on the mercy of God.

"The treasures of the world must rush to you, when you have attained the state of desirelessness." PATANJALI).

'Compensation', 'Action and Reaction', 'Air rushing to fill a vacuum' and 'A magnet attracting iron' are some of the pictures that come to our mind. when we think of the miraculous manner in which the external world responds or reacts to man's inner mental state. The author believes his Response Theory is of tremendous significance.

GROUP AND SOCIAL PROCESS

15. Social Relations in an Indian town.

Prabha Khanna, Delhi.

Leaders of public opinion in a small town are

(1) officers of the Government,

(2) agency holders and commission agents of manufactured goods, and

(3) owners of small industries.

Those who have money play safe in small towns and invest their money in safe business. The spread of education and easy means of transportation stimulate aspirations of the "have-nots". Though there is plenty of opportunity for repair shops and new industries to be started in small towns the insecurity amongst those who have the means makes them shy of taking risks. The brilliant and the capable move to big cities and the mediocre leadership in small towns becomes very conservative. Hence there is no sustaining and subsidiary economic and industrial activity to support what is already there. This makes for a poor integration of small towns. Since most people cannot acquire a new notion of self-respect through gainful occupation, they seek power and authority through joining political parties. Haranguing and emotional appeal to crowds become their speciality. The masters of words then inhibit the skilled workers and technicians being the leaders. The whole situation has a baneful effect on constructive disposition of the population. This leads to an acute state of tension resulting in social pathology. The average citizen conforms to the social climate operating in a small town.

16. Comparison of two opinion surveys regarding the formation of linguistic states.

B. Kuppuswamy, Madras.

In January 1951, a report on this problem was submitted to the Science Congress. That investigation was conducted on 217 students of the Presidency College, Madras, in October 1950. Six months later, in March 1951, the same questions were asked of 591 students belonging to 12 Colleges in the Madras State. The present paper shows that the results of these two investigations have differences of less than 6% in most comparisons. It is only when the number in the group is very small as in the case of Kannada students and in the case of 'No, later' responses the difference goes beyond 10%.

17. Measurement of social distance.

B. Kuppuswamy, Madras.

The paper reports the result obtained by the use of the Bogardus Social Distance test from 591 students enroled in 12 different Colleges in Madras State 18.1% have asserted that they will admit each one of the eight groups : Brahmins, Christians, Harijans, High Caste Non-Brahmins, Lower Caste Non-Brahmins, Muslims, Parsis and Sikhs, to each one of the six social relationships, viz., Kinshiply marriage, taking food in one's dining room, intimate personal friend, guest, neighbour and acquaintance. Of the remaining,, 80% have given restricted approval to each group while 1.9% have not given any response. 20% of the whole group have totally excluded one or the other of the eight groups from every degree of social relationship. An attempt is made to graphically represent the social distance of each group from the various given groups on the basis of the 'yes' responses.

18. Anti-Muslim attitude of a group of Bengali and Bihar boys.

S. K. Mitra, Patna.

This study is an attempt to find out whether Bengali boys, whose emotional involvement in the partition of Bengal is presumably greater than that of Bihari boys, are more anti-Muslim than the latter; and whether the two groups, in view of their cultural differences, show significant differences in the content of the said attitude. The study is based on data collected simultaneously from two groups of school boys — a highly selected sample — who were given several tests of anti-Muslim attitude and a questionnaire for personal data. It presents problems for further research rather than definitive answers to questions raised.

19. Social & Psychological consequences of the working of the judiciary.

Nahar Singh, Aligarh.

The process of the ministration of justice in India has been subjected to a careful scrutiny by the author who happens to be a Magistrate. The custom of examining the prosecution witness first gives plenty of opportunity to the accused to hit upon suitable defences and he therefore starts experimenting with various devices of extricating himself from the situation. This promotes the fabrication of false evidence and false witness and makes for malingering in the population with serious pathological results for the people. This current practice has resulted in creating a full-time profession for a number of people who earn their livelihood by promoting false evidence. A case is made out for establishing the convention in Indian Courts of recording the statement of the accused and his defences first. Along with this the prosecution of those implicating others in false Court cases should be initiated by the Government. The poor people implicated in false cases have no money to ask for a trial of their persecutors and therefore take resort to vendetta. This promotes perpetual feuds in the country. There is a whole army of medical practitioners who make their living out of issuing false medical certificates to help criminals through obstructing the process of justice. The paradox of the process of justice promoting crime has to be squarely faced. The whole process of the ministration of justice has a demoralizing effect on the population and paralyses them against taking to constructive pursuits.

Remedial measures have been detailed in the paper.

INDUSTRIAL AND OCCUPATIONAL PSYCHOLOGY

20. What men want for their jobs.

Asit Deb, Calcutta.

A survey has been made of 'what workers aspire to get out of their jobs' in different industries. A specially designed questionnaire was used in interviewing individual workers. A number of office assistants has been similarly examined. Differences in preferences according to age, education, experience in service etc., has been worked out.

EDUCATION AND TEACHING METHODS

21. Music, the hand-made fo Psychology.

BANI CHATTERJI, Calcutta.

Psychology is applied with success to solve life's many problems. Its field of application is very wide and a large part of it yet remains untravelled and unexplored. In its further attempts to explore these regions, psychology should find in music,—which, too, deals with human emotions—a ready and practical help and ally. In fact, Psychology and Music are in many respects complementary. Music makes it possible to demonstrate in a concrete way relations amongst emotions implied in the theory of Psychology. Their conjoint application is possible and desirable in practical life. We often noted the child's natural aptitude for music, and therefore music has a definite place in the education of the child. The practical applications of music have been experimented with abroad. There is plenty to learn from European countries as to the best use of music in child-psychology. The hospitals of India, too, should welcome this suggestion of a joint effort by Psychology and Music, in view of music's diversional and therapeutic values.

22. A Study of Gifted Children.

K. D. GHOSE, Calcutta.

The great importance of the study of this subject : Methods of investigation to be followed in India. The usual methods of selection of gifted children in America : The I. Q.—The methods or criteria by which gifted children were selected in certain families in the present instance : The ratings on the tenpoint scale : The characteristics of the children studies : Certain popular misconceptions and beliefs removed : Special treatment recommended in each case.

23. History of Science and some problems in Teaching.

A. RAHMAN, Hyderabad-Deccan.

The present compartmentalisation of science and narrow specialisation is deplored and efforts are being made to devise ways and means to give training to people who can be called generalists. The paper stresses the importance of the History of Science in bringing about a broader and more deep understanding of Science. It further emphasises the role of History of Science in developing a proper understanding of the growth and development of modern Universities and the problems that face them. The paper suggests that the division between Science and humanities is only a historical division while the division that has come to be is the division between the fundamental and the applied Sciences. The paper analyses these problems in their historical context with special reference to India and the problems that are faced to-day.

EXPERIMENTAL PSYCHOLOGY

24. Psychology of the female sex.

S. M. MOGHNI, Aligarh.

The title suggests that the two sexes differ psychologically, there there are certain psychological characteristics which are essentially of a masculine nature, while there are certain others which are essentially of a feminine quality. The arguments advanced in this paper are based upon the recognition of this difference. In almost all our normal human relations this distinction occupies a very important place. The question is whether it is innate or acquired. It seems to be primarily innate and only secondarily an acquired phenomenon. If so, has this distinction any biological foundation? Both anatomy and physiology do throw light on this problem, and their studies that the anatomical structure as well as the physiological function of the genital organs, as also the secondary sexual characteristics, have a tremendous influence on the psychological make up of the individual. While these biological limitations have to be recognised and given a primary consideration, the influence of socio-cultural and socio-economic factors cannot be ignored. Recent researches in child psychology, social and abnormal psychology and anthropology clearly bring out the influence of biological as well as of environmental factors.

2. The female sex in Indian culture.

S. M. Moghni, Aligarh.

The bisexual disposition present in an individual at birth is the result of many forces operating at the prenatal stage which have not been sufficiently disentangled. Every culture has developed social institutions which bring a certain balance in the male-female components of personality and thereby brings a certain poise in the individual. This point of view has been illustrated with material for cultural anthropology.

The new roles that have been enforced on men and women in India at the present juncture have resulted in the upsetting of the balance in the bisexual components of personality. This point has been illustraetd with the help of clinical material. The social and personal consequences of masculine-feminine conflict in the individuals have been pointed out. The social forces making for this conflict have been analysed. Suggestions for reducing this conflict have been recommended.

26. Immediate recall and presentational stress.

William Adiseshiah, Delhi.

Following Bartlett's experiments involving the use of the Method of Description, a series of experiments was carried out on service personnel and College students in the U. K. The task consisted in reproducing, by short verbal description, three sets of simple line drawings, with nine items in each set. Some of these items bore latent connections with others. All the drawings were presented techistoscopically. In scoring for accuracy, cases of correct recall of presented items and correct placing in the presented sequence were adopted as bases. On both counts, it was evident that breakdown or recall occurred at the *middle*, rather than at the beginning or the end of the sequence. In the identification of latent connections between items in sequence, items which occurred at the beginning and at the end of the sequence had significantly greater identification value. Where, in the course of immediate recall, some shifting in the position of the items occurred, this affected the middle, i.e., between the third and the sixth items of the sequence. It was therefore concluded that presentational stress undermines the recall value of a short sequence in its mid part. This was confirmed by increasing the duration of the presentation of items 3 to 7 and by reducing the number of items for recall from nine to three at a time. In the former case, efficiency increased by over 30% and in the latter case, efficiency increased by over 50%. There was no significant difference between the scores of College students and Service Personnel.

27. The perceptual efficacy of serial material.

William Adiseshiah, Delhi.

A series of simple experiments was carried out at the Cambridge Laboratory, to investigate the accuracy of response to serial material, in an expermental task involving Immediate Recall. The material consisted of five diffenent sets of dot patterns. Each set consisted of five items, progressing in a series. The material was presented in three ways : (1) Each item displayed as a separate unit; (2) Each series, i.e., five connected items displayed in one lot; (3) All the five series displayed in one lot. The order of presentation was randomized by the use of a 5 × 5 Latin Square.

Significant differences were observed as regards accuracy of recall when observers were dealing with isolated as compared with serially presented items. It was concluded that the response to a single item of information may be different according as to whether it appears in a series or not; and also according as to whether it appears in a successively presented series or a simultaneously presented set. It is certainly unsafe to base anything general about recall on results with isolated items, and this is all the more likely to be true if the performance required is further removed from perceiving itself.

METHOD OF PSYCHOLOGY

28. Life History as a method of Tension Study.

Ranajit Kumar De, Calcutta.

Life histories of 103 male refugees of West Bengal, (all of them Bengalee Hindus) of different age levels and caste-groups and randomly selected, have been recorded on specific lines designed to elicit direct information about the social life of the subjects in Pakistan during communal conflicts and their present economic and social status with difficulties they are experiencing in India for adjusting to the new conditions of life.

The individuals studied belong to two different refugee groups. One group was rehabilitated by the Government and the other settled themselves by their own efforts and initiative.

The need structure as the functional basis of tension is critically analysed in the paper in relation to the consequences of frustration and the resulting behaviour pattern and social change. A comparison is also made between the two groups in the light of the above analysis.

PSYCHOLOGY OF PERSONALITY

29. Indian adaptation of the Thematic Apperception Test of Murray and its application on Indian population.

Uma Chowdhary, Calcutta.

Murray's Thematic Apperception Test was evolved from his clinical experience of American subjects and was built on the cultural pattern of European civilization. After experimenting with Indian situation for several months, an abridged series of

12 cards were selected from the original 20 cards set and these were adopted after trials and tests on Indian subjects and were based on Indian life models and imaginary drawings. These were then applied in the field and final selections were made from the experience gained.

30. Tension Among the Students of the Lucknow University.

KALI PRASAD and S. ZAFAR HASAN, Lucknow.

This paper is based on a social tensions survey among the students of the Lucknow University. It is a part of the work started under the auspicies of the UNESCO. It deals with the responses and attitudes revealed by the questionnaire, which covers different aspects of the communal relationship.

31. Towards Measuring Social Distances.

N. S. N. SASTRY & S. K. R. RAO, Bangalore.

The paper embodies the report of the work done in connection with the measuring of social distances between different groups in India. On the basis of a questionnaire preferences in regard to types of social reaction was noted for a group of 70 Gujarathi teachers. The results were treated statistically. The mean ranks and coefficients of variation were worked for the entire group. The result unmistakably points to factors operating in the formation of ingroups. The outgroup influence also is indicated. The resulting structuralisation of the social field is discussed.

32. Need of Psychological Test in the field of Indian Education.

HARERAM HAZRAH, Asansol.

Progress of Education in India is being handicapped with multifarious defects, inherent in the system itself, the most glaring of which is the lack of psychological selection of boys for the right type of education, suited to their individual tastes and capacities. It is a pity that all our students, irrespective of their bent or ability, are grouped together and pressed through the same form of mechanical education which has scarcely any touch with the changing needs of our country to-day.

It is an well-known fact, that, in our schools and colleges, the dullards or the backwards, nay, even the idiots too, are placed in the same form, which include the normals and some brilliants perhaps, with this result that neither of the types are benifited by the trade-mark teachings of the helpless teacher, who is placed in the ocean of embarassment by the admixture of odds in the same class. This must be ended in no time, and psychological selection of boys should positively be introduced in some model schools, if not in all.

It is highly desirable, that there should be at least one teacher, specialised in educational psychology, who, with the assistance of some trained hands, should conduct proper grouping of boys according to their respective I.Q., with the ruthless elimination of the abnormals, who, however, might be conveniently sent to some special schools, to be specially started, for the education of the problem children. No sane man can deny that this sort of intelligence testing and psychological grouping of boys is an indispensible part of education, if it is to be real and successful.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF AGRICULTURAL SCIENCES

President : Mr. K. L. KHANNA, B.Sc., (Agric.), F.A.Sc.,

Abstracts

1. On the prediction of Sugar Recovery.

K. L. KHANNA, S. C. SEN and K. S. BANDYOPADHYAY, Pusa, Bihar.

The information furnished in the Run Reports of sugar factories was made use of in an attempt to see if it was possible to predict sugar recovery with dependable accuracy from the entries recorded in these reports. Regression analysis of sugar recovery on one hand and the following attributes viz. (i) sugar% cane, (ii) Brix and Pol. primary juice and (iii) Brix and Pol. primary juice and sugar % cane. The amount of association was significantly high in all the three cases admitting of the possibility of an efficient prediction of sugar recovery. The introduction of sugar % cane as an additional independant variable over and above Brix and Pol. primary juice gave rise to a significant increase in the amount of information. The additional information afforded by Brix and Pol. primary juice over sugar % cane was also of a significantly high order.

2. On the classification of Wheat samples.

K. B. SHARMA, K. S. BANDYOPADHYAY, and K. L. KHANNA, Pusa Bihar.

Nearly 2500 samples of wheat collected from different areas of Bihar were classified into three different grades by close inspection with naked eyes, according to the physical appearance of the grains. The length and girth (diameter) of the grains of the graded smaples were subsequently measured by Slide Callipers, while samples of 20 grains weighed in a sensitive chemical balance. The way in which the dimensional and gravititional measurements divided themselves into three distinct categories revealed that it should be possible to clearly differentiate wheat grains in terms of numerically measurable quantities, without having to depend upon eye-estimation. The measurements in respect of the different grades were obtained as follows:—

	Wt. of 20 grain in gms.	Length of grains in mm.	Girth diameter of grains in mm.
Class I Above	0.6766	6.08	3.04
Class II Above	0.4307	5.65	2.53
Class III Below	0.4307	5.65	2.53

3. Studies of Sampling Technique. Rind Hardness in Sugarcane.

S. L. SHARMA and RAJESHWAR PD. Pusa, Bihar.

Sampling technique is given for the estimation of rind hardness for varieties in early stages of multiplication and for those covering large area. For the former category, 25, 100 and 500 canes will be sufficient to give this character within a margin error of 5, 2½% and 1% of the mean, while for the latter the number of stalks to be tested would be respectively 50 250 and 1250 taken from rows, units, clumps according to a certain plan. All measurements have to be taken on the side opposite the bud at the mid-point of middle internodes.

4. Associated growth of Legumes and Cereals.

B. V. VENKATA RAO and S. V. GOVINDARAJAN, Bangalore.

Legumes and Cereals are commonly grown in associated growth on an impirical basis in the belief that the crops benefit by such association. Experiments have been conducted over a number of years on both plot and field scales using different crop associations and in different preparations, the cereal studied being Ragi (Eleucine coracana) and the legumes groundnut and soyabeans. It is found that increased crop yields of 10 to 5% in both the cereals and legumes are obtained depending on the proportion of the crops when grown in association, compared to the yields that will be obtained if each of the crops were raised as pure crops separately. Association in equal proportion appears to be better than other levels. Increase of pressure on unit of land, over and above the normal crop spacing seems to depress the Ragi yield without having any adverse effect on the crop yield of legume, which under the experimental conditions seems to improve at the cost of the cereal.

5. Mixed cropping of Wheat and Gram as an insurance against Rust.

ALBERT S. De QUADROS, Gwalior.

Studies on mixed cropping of wheat and gram extending over five years have revealed that in (i) a bad rust year wheat in mixed cropping is less severely infected and (ii) when rust appears late in the season and a separately grown wheat crop shows 20-30% infection, in mixed sowings it escapes attack altogether. With a view to understand the likely reasons, random samples were collected of soil, roots and green parts of the mixed crops viz. wheat and gram and studied for pH. This while no marked differences were observed so far as pH was concerned, the green parts of both gram and wheat were found to be highly acidic and acidic respectively in the mixed cropping. The leaves and pods of gram on the growing crop are coated with a thin film of vegetables acids (oxalic and malic) either encrusted on them or dissolves in the dew which settles on the plants. These acids were also found to be present in patches on wheat plants growing with gram, having obviously been imparted by contact. This mechanical factor would account for lesser damage by rust to a wheat crop grown in association with gram due to a reduced field for rust spores to germinate in.

In view of the serious incidence of rust in the country and lack of immune strains of wheat, the author pleads for the adoption of practice of mixed cropping of gram and wheat as an insurance against failure of wheat crop due to rusts.

6. Comparative efficacy of Agroxone & Phenoxylene 30 as a Weed-Killer.

S. L. SHARMA and M. Z. HASSAN, Pusa, Bihar.

Studies were undertaken at the Central Sugarcane Research Station, Pusa to determine the effectiveness of two week-kikkers viz. Agroxone and Phenoxylene against a large number of kharif and rabi weeds. The results showed Agroxone to be more effective as a weedicide as also quicker in its action than Phenoxylene 30. It appeared that the substitution of H in M. C. P. A. by Na had reduced the potency of the acid as a weed-killer.

7. Imbibition of water by seed of Jowar Varieties.

V. K. DESHMUKH and U. K. KANITKAR.

Water content of seedlings of M 35-1, J-8 and Nadyal varieties of **Jowar** has been observed to differ. It is also found that seed treated with 2, 4-D solution gives rise to seedlings different in their water content and other water relations as compared to those raised from untreated seed. It is also known that 2, 4-D treatments improve the growth of seedlings of **Jowar.**

In order to find the cause of this difference in behaviour of seedlings, the state of the soaked seed was investigated. On soaking the seed of M 35-1, J-8 and Nandyal varieties of jowar in water for 20 hours, it was found that seed of J-8 absorbs water equal to 36.13 % of its own weight, M 35-1 33.16 % and Nandyal 31.04 %, the differences being statistically significant. The seeds of these varieties differ in their capacity for imbibition, the difference being due probably to difference in the Plastic material contained in the seed.

Seed of Nandyal variety of **Jowar** was soaked in water, in 10 p.p.m. 2, 4-D solution which is found to accelerate the growth of seedlings and in 100 p.p.m. 2, 4-D solution which is found to retard the growth. On soaking for 20 hours, it was found that the amount of water absorbed by the seed under the two treatments was the same, showing thereby that the difference in growth of seedlings was not due to differences in hydration level of seeds due to soaking. It is possible that since different concentrations of 2, 4-D solution are used for soaking, correspondingly different amounts of 2, 4-D may penetrate into the seed and thus cause difference in growth of seedlings.

8.Agronomic possibilities of Mustard Vernalisation in India.

S. C. CHAKRAVARTI and O. N. CHAND Agra.

This work was undertaken to determine the effect of vernalisation on the yield of grains in mustard. Two field trials were carried out; one with the treated and untreated seeds of T.10S. 13 sown at the spacings, 24″ × 16″, 24″×12″ and 24″ × 8″ and the other with those of Aghi, Piva, B 2/5, T.10 S. 13, T. 11 S.5, T. 466, T. 4101 and T. 4106 sown at 24″ × 12″.

Use of treated seeds resulted in a statistically significant (% level) loss of yield of grains to the extent of 43.68% in the first and 27.07% in the second experiment. Thus, there appears no scope for the use of vernalised seeds of mustard in the agricultural practices of this country.

9. Activation of growth of seedlings of wheat by treatment of seed with 2, 4-Dichlorophenoxy acetic Acid.

S. S. PATIL and U. K. KANITKAR, Poona.

2, 4-Dichlorophenoxy acetic acid is known to inhibit plant growth in dicotyledonous weeds and as such is used as a weedicide spray. It is known to be less effective on monocotyledonous plants like cereals, etc. Most workers have dealt with the retarding effect of 2, 4-D on plants but the present paper describes the capacity of this same substance of stimulate Plant growth thus opening out a possibility of the substance being utilised in a different way.

Ethyl ester of 2, 4-D was used for treatment of seed of wheat (N.P.4) in concentrations varying from 0.01 p.p.m. to 100 p.p.m. and for durations of 12 minutes, 2 hours and 20 hours. The seed so treated was germinated in soil in pots under uniform conditions and the resulting seedlings were examined.

The results show that:—

(i) 2, 4-D as ethyl ester is effective in a cereal crop such as wheat, (ii) a mere seed treatment with 2, 4-D is found to result in considerable changes in growth of seedlings, (iii) some treatments are found to accelerate growth in height and fresh weight of seedlings significantly while others are found to retard the same, and (iv) that the nature and amount of response to 2, 4-D is found to depend upon the total stimulus given by the treatment which depends upon two factors viz. concentration of 2, 4-D solution used and the duration of treatment.

10. Differential response of Cicer Arientinum, L. To treatment of seed with Ethyl Ester and Sodium Salt of 2, 4-D.

M. K. MOOLANI and U. K. KANITKAR, Poona.

Treatment of gram seed with 2, 4-Dichloro-phenoxy acetic acid has been found to affect germination and growth of seedlings. This substance is available in various forms known as 'Weedone' an ethyl ester of 2, 4-D and as 'Fernoxone' a sodium salt of 2, 4-D. The efficacies of these two preparations of 2, 4-D have been tested in regard to their effect on germination and growth of seedlings of gram (**Cicer arietinum** L.).

Germination trials were taken both on moist filter paper and in soil. In the case of filter paper trials, fernoxone was found to give more germination as compared to weedone. Both of these preparations of 2, 4-D were found to increase the germination up to a concentration of 0.1 p.p.m., beyond which there was generally a retardation. This retardation was very prominent in the treatments beyond 100.0 p.p.m., it being more in respect of weedone as compared to Fernoxone. Under higher concentrations, germination was meagre, the radicle being found just to burst out of the seed coat and progressing no further.

In soil, the 12 minutes treatments was not effective in retarding germination. In 2 hours and 20 hours, all the treatments beyond 10.0 p.p.m. completely inhibited germination, in 0.1 and 1.0 p.p.m. treatments, weedone being more effective compared to Fernoxone. Under the treatment of higher concentration of 2, 4-D examination of seed in soil showed that the negative result found was due to weak plumule not being able to come out of the overlying soil after release from the seed coat. Since the results in soil are rather misleading on account of this apparent negative result, the conclusions are drawn from filter paper trials which indicate a greater effect of weedone as compared to Fernoxone in respect of germination of gram **(Cicer arietinum,** L.) Var. 'Chafa'.

11. Physiology of Fibre Growth in Jute (Corchorus).

B. K. KAR and B. K. DEY SARKAR, Hooghly.

The yield of fibre in Jute is proportional to the height of the plant and its basal diameter. But detailed information on the rate of growth of fibre at different stages of the plant, its relation with the growing height of the plant and its relation with the growth of other stretures such as wood aand bark is still lacking; knowledge on the variations in growth of these structures, in coordination with the total growth of the plant at different phases in its life history, is essential to understand the nature of the growth of the fibre elements in different commercial types and to enumerate their correct values. With this aim in view studies were begun on the following varieties both from capsularis and olitorius, the two important commercial species from which the fibre is obtained :—

A—Capsularis :—D154, Fanduk, C41-13, C39-212, C42-Kj-320
B—olitorius :Chinsurah Green, R26, O-40-632, 0-39-620, 0-40-753

Periodic estimations were made in growth rates in terms of dry matter produced in the different regions of the stem at different phases of growth and development and continued throughout the life cycle of the plants. The important results obtained are enumerated below.:—

The weight of fibre exceeded from that of wood in their vegetative stage, bud stage and flowering stage. (2) In pod stage the weight of wood exceeded from that of bark. (3) The ratio was differently maintained on the stem according to the stage and height of the plant i.e. secondary wood formation took place from the bottom and advanced up the stem, thus shifting the fibre ratio towards the apex. (4) More fibre was laid in the upper regions of the stem during the flowering stage. (5) Both D154 and Chinsurah Green behaved similarly, in a general way with specific differences. (6) The specific difference noted from the comparative rates of growth of wood and bark was that the vigour of growth was more in C.G. in earlier vegetative stage than in D154. But D154 completed the same in later stages of bud to flowering periods when the maximum fibre ratio was also recorded. (7) Throughout the changes in bark growth and wood formation a definite ratio was maintained which in the present studies varied from 0.8 to 1.4 in C.G., 0.7 to 1.3 in D 154 which is almost the same in both species, showing a close co-ordinative growth between bark and wood structures.

12. Effects of Soaking Cane Setts prior to Planting on Juice quality.

S. C. SEN, Pusa, Bihar.

In view of the varying results obtained with soaking setts a detailed study was undertaken. The experimental results showed that setts when soaked in either 25% solution or that of higher concentrations from molasses, gur, glucose or cane sugar such that they floated over the surface of the solution, gained in carbohydrate content (glucose and cane sugar). This, however, was not the case when setts were soaked in solutions of lower concentrations and where they greatly sank down. Here the carbohydrate content decreased indicating transfer of sugar from the sett into the solution. This was particularly the case when water alone was used as a soaking medium. Further the planted setts containing higher initial sucrose content resulted in better juice quality at harvest compared to the crop raised from setts of poor sucorse content. Plantings with top setts also showed higher sugar values compared to bottom sett plantings.

13. Effect of lodging and tillering at the Epical Region of the stem on Juice quality of Sugarcane Crops.

S. C. SEN and N. MALLIK, Pusa, Bihar.

The sugar recovery during the year 1949-50 in almost all the factories in North Bihar, was lower by about 1.0 percent compared to the previous year. Due to this sudden drop in the recovery, the authors surveyed a large number of cane fields in order to find out the various factors responsible for such a drop. It was observed that besides topping canes to meet fodder scarcity, the crop had badly lodged due to severe cyclonic weather during September and that the standing crop in general had developed large number of side shoots particularly in the apical region of the stem giving the appearance of a heavy top growth. The analytical results showed these causesled to a serious deterioration in juice quality and this was in agreement with the observation of Greet.

14. Uptake of Phosphatic Salts by Sugarcane Plant in water cultures.

S. C. SEN and B. K. CHOUDHARY, Pusa, Bihar.

The present investigation is a continuation of the work of Sen and undertaken with the object of finding out the rate of absorption of phosphatic anions when different phosphatic salts are added along with ammonium nitrate and potassic salts. The results show that the rate of absorption of phosphatic anions in different phosphatic salts is of the order: magnesium phosphate, calcium—phosphate (double super) and sodium phosphate. This absorption of phosphatic anions as well as nitrogen increases with the supplementation of potassic salts in ammonium nitrate medium, showing that the presence of potassium salts favours absorption of other nutrients. Further, that the rate of absorption of nitrogen and phosphatic anions is greater in setts soaked in 30% gur or molasses solution compared to the non-soaked control.

15. Influence of minor elements on Mysore Soils and Crops. Response of Ragi to Zinc Salts.

S. V. GOVINDARAJAN and H. G. GOPAL RAO, Bangalore.

Certain initial trials have indicated the beneficial effect of application of zinc salts to Bangalore soils in giving higher yields of Ragi **(Eleucine coracana)** crop. Extensive experiments were conducted on field scale in several parts of Mysore State to confirm these observations and to obtain information on the crop response under different soil conditions.

Zinc sulphate, at 5 to 10 lbs. per acre was broadcast along with the usual dosage of manures at the time of sowing, cultural and other operations being normal. The treated plots, in the majority of experiments have given higher yields of grain and straw, the increases averaging about one palla of grain (about 200 lbs.) and 200 lbs. of straw, per acre, thereby indicating the possible deficiency of zinc in these soils to meet the nutritional requirements of this crop. The economics of the treatment are given.

16. Symptoms of Manganese deficiency in Common Crops of Gujrat.

C. C. SHAH and N. M. PARIKH, Anand.

Manganese is one of the few micronutrients which is important for the healthy growth of plants. The common symptoms of manganese deficiency is chlorosis of upper leaves, formation of necrotic spots on the leaf surface, narrower stem and accumulation of calcium oxalate in cells.

Gujrat soils on an average contain sufficient manganese, and the chances of occurence of manganese deficiency on Gujrat soils are remote. However, application of liming materials and organic manures is likely to convert the available manganese of the soil into a non-available form, with development of manganese deficiency symptoms.

The symptoms of manganese deficiency in common field crops of Gujrat, viz. Bajri, Jowar, Tobacco, Cabbage, Cauliflower, Tomato and Oats have been studied. Specific symptoms of manganese deficiency in these crops were obtained by growing them in sand and supplying nutrient solution containing varying amounts of manganese.

The specific symptoms of manganese deficiency were cured in each case by curative treatment of spraying with 0.1% manganous sulphate solution.

The symptoms are tabulated below:—

Crop and part of the plant analysed.	Time of first appearance of symptoms.	Symptoms.	Mn. p.p.m. in deficient plant.	Mn. p.p.m. in healthy plant.
Jowar Leaves	35-40 days after germination.	Edge-necrosis of leaves.	4-6	46-60
Bajri Leaves	60-62 days after transplanting.	Leaves yellow with patches of green.	6-10	40-42
Tobacco Leaves	60-62 days after transplanting.	Leaves chlorotic with a pattern of green and white. Necrosis of leaves.	30-40	100-140
Cabbage Leaves	44-46 days after transplanting.	Leaves smaller and yellow in colour.	15-30	100-150
Cauliflower Leave	30-35 days after transplating.	Leaves smaller and from the edges to the mid-rib.	30-40	120-160
Tomato Leaves	26-28 days after transplanting.	Brown colour of the leaf yellow and then fall down. Plant stunted in growth.	10-15	60-70
Oats Leaves	18-20 days after germination.	Lower leaves become colour on the leaf.	24-28	50-60

17. Studies of the Activity of Manganese in Calcareous Soils.

P. B. BHATTACHARYYA, K. L. JONEJA and K. L. KHANNA, Pusa, Bihar.

Calcareous soils of North Bihar are characterised by a high content of free calcium carbonate, high pH values and low reserve of organic matter. These soils are sandy loam to loam in texture, are adequately supplied with air and possess highly satisfactory drainage characters. Under such chemical and physical set-up, oxidative reactions are uppermost within the soil, and activity of soil manganese sinks down to a minimum. An application of sulphur in conjunction with easily oxidisable organic matter induces conditions for greater availability of soil manganese not only by lowering of the pH value but also by utilising and removing the available soil air. As the soil air is being progressively depleted during the process of oxidation of sulphur and easily oxidisable organic matter, a reducing condition is brought about which promotes the formation of the divalent soluble manganese, the progress of intrification being essentially an oxidative reaction, is at the same time considerably slowed down.

18. The effect of continuous manuring with Nitrogenous, phosphatic and Potassic fertilizers on the population of Azotobacter Chroococcum and on total bacteria in the soil.

B. N. PRAMANIK and A. N. MISRA, Shahjahanpur (U. P.)

Comprehensive experiment to ascertain the effect of nitrogenous (sulphate of ammonia,), phosphatic (superphosphate) and potassic (Potassium sulphate) fertilisers on sugarcane was started in 1935-36 at the Government Sugarcane Research Station, Shahajahanpur. The experiment has been conducted on two fields in alternate years with three doses of nitrogen (0 lb. 100 lbs. and 200 lbs. per acre three doses of potash and phosphate (0 lb., 75 lbs. and 1500 lbs. per acre) together with their combinations.

The bacteriological studies revealed that continuous application of concentrated nitrogenous fertilisers (sulphate of ammonia) decreased the total number of soil micro-organism, Azotobacter chroococcum and hampers nitrogen fixation by creating unfavourable soil reactions. The pH of plats recieving 200 lbs. nitrogen per acre has been appreciably reduced and continued cropping with sugarcane has lowered the C/N ratio in all the plots. The relative fall in yield of sugarcane from the year of commencement of the experiment to that under discussion is greater in 200 lbs. nitrogen treated plots than in others.

Application of phosphatic fertiliser creates favourable condtiions for the growth of Azotobacter sp. and other soil microorganisms. It increases the nitrogen recuperative power of the soil by increased bacterial fixation of atmospheric nitrogen. The beneficial effect of the phosphate has not resulted in higher yield presumably as these were applied as top dressings and thereby got im-mobilised in the surface soil. Potassic fertiliser on the other hand, depresses nitrogen fixing capacity and thus hinders soil recuperation. Hence, it does not lead to increased yields.

The Azotobacter plaque test may be utilised for comparing the availability of various phosphatic fertilisers.

19 Losses of Nitrogen from Urine under different conditions.

M. R. MADHOK and LEKH RAJ DHINGRA, Ludhiana, East Punjab.

Some experiments were conducted on the losses of Nitrogen from urine under different conditions. The results obtained have led to the following conclusions:—

(1) Losses are directly proportional to the quality of urine added to the soil, being 81.6 in the over saturated soil compared to only 17.0% in the case of quarter saturated soil. (2) The losses of nitrogen are very much less if urine earth is quickly dried in the sun; the loss being only 6.1% as against 28.0% in the shade dried soil. (3) Dilution of urine with water considerably reduces the extent of losses and the reduction is proportional to the amount of water upto the limit tried i.e. one to ten (1:10).

20. Influence of temparature and pH on the C/N ratio of soils in Bihar.

S. C. SEN, Pusa, Bihar.

The present investigation is a continuation of the work of Dhar and Palit and undertaken with the object of making a further and critical investigation on the C/N ratio of soils of the sugarcane growing tracts of Bihar.

Results of detailed soil analysis of thirteen different sites in North Bihar and ten different ones in South Bihar and Chotanagpur area indicated that there was a greater release of nitrogen in soils of lower pH compared to those of higher pH in the same locality. At Majhaulia and Motipur, the highly calcareous belt, the rate of release of available nitrogen is higher in soils of lower pH than calcareous soils of the same tract, whereas, at Harinagar, Lohat and Siwan—the non-calcareous belt, the rate of release of available nitrogen is lower in the soils of higher pH i.e. the rate of protein oxidation decreases with the increase of soil pH.

The C/N ratio of soils of North Bihar varied widely, ranging between 6.0 and 11.4, whereas that of soils of South Bihar and Chotanagpur varied between 9 and 13. In a positive correlation between the C/N ratio and the release of available nitrogen was observed. Although these soils contained more nitrogen and higher C/N ratio compared to calcareous soils, yet the rate of release of available nitrogen was lower than the calcareous soils, a phenomenon contrary to the observations of Mclean, Dhar and others in normal soils, due probably to the presence of more Azotobacter colonies in calcareous soils. The alkali soils indicated definitely lower C/N ratio as well as lower release of available nitrogen.

The results also generally showed positive correlation between C/N ratio and cane yield but no such indication was available so far as sucrose content was concerned.

21. Reactions of different concentrated solutions of Methylene Blue during estimation of reducing sugars with Alkaline Potassium Ferricyanide solutions.

S. C. SEN and R. K. GHOSAL, Pusa, Bihar.

The present investigation is a continuation of the work of Khanna and Sen and undertaken with the object of establishing the strength of methylene blue solution which is added as an internal indicator to potassium ferricyanide solution for the estimation of reducing sugars. The best and sharp end-point was obtained with 0.3 and 0.5 per cent methylene blue solutions (B. D. H.) but by the addition of even one drop more of 0.5 percent methylene blue solution, the results are affected, whereas, by the addition of extra two or three drops of 0.3 percent methylene blue solutions, the results remain unaffected. Generally, two to three drops of methylene blue solution are added during estimation, as such, 0.3 percent methylene blue solution has been recommended as an internal indicator to Potassium ferricyanide solution for the estimation of reducing sugars in place of 1.0 percent methylene blue solution, which is usually applied.

22. A simple method for the estimation of Nitrate Nitrogen in calcareous soils.

S. C. SEN and M. FAROOQUE, Pusa, Bihar.

North Bihar soils which constitute the major white sugar tract of the State are highly calcareous containing upto 35% of $CaCO_3$. Due to this, the standard methods applicable to normal soils often given eratic results. The Morgans R. C. M. test for the estimation of NO_3-N had therefore to be modified and a new colour range perscribed. The results showed a very close correspondence (within a limit of 3 mgm of NO_3-N per 100 gram soils) between the values obtained by the new R. C. M. test and the standard method.

23. The chemical electrochemical and viscus properties of clay fraction isolated from a clay loam soil of West Bengal.

B. CHATTERJEE, Sibpur.

2—micron (0.002 mm) fraction has been isolated from a clay loam soil collected from Tollygunge (Calcutta), using the International Soda method. This fraction is converted into H-clay by repeated leacing with 0.03 N-Hcl. excess acid washed off with distilled water, finally dispersing the collodial clay in redistilled water. The results of fusion analysis of the H-clay, (SiO_2, 57.00%; Al_2O_3, 31.83% Fe_2O_3, 9.17%, CaO, 0.24%; K_2O, 1.67% and MgO, 1.04%) indicate that the clay mineralogical make-up of this clay is: 25% montmorillonite, 30% illite and 45% kaolinite. The pH-alkali concentration curve is apparently similar to that of montmorillonitic clays in that it shows an initial rise and a buffered region followed by a somewhat sharp inflexion at pH 7.6. The base exchange capacity calculated at this point comes to 44.0 milliequivalents per 100 gms. of clay, the viscosity-alkali concentration curve showing the presence of appreciable amounts of montmorillonitic clays as shown by the relatively small increase in viscosity on the addition of increasing amount of NaOH. Further, appreciable amounts of illite and kaolinite are present in this clay as shown by the results of fusion analysis and the nature of the visosity curve.

24. Studies in the reaction of Bihar Soils I. Fluctuation in acidity and lime requirement of soils.

S. C. MANDAL and H. N. MUKHERJEE, Saboor, Bihar.

Soils of Islampur State farm have a sandy loam surface soil with a sandy subsoil. They are rich in the nitrogen, organic matter and phosphates soluble in

1% Citric acid but exhibit medium to strong acidity which leads to miserable failure of crops. An investigation was made to find out the nature and extent of variations of the pH of this farm and it was found that it varies from 4.7 to 6.8.

Lime requirement experiments set up on the bases of such variations indicate that it may not be judicious at present, from the stand points of calcium nutrition and acid toleranece of crops to be grown, elimination of toxicity, over liming injury and economics of liming, to raise the pH above 6.0. At present an application of $CaCO_3$ @ 1500 lbs. per acre seems to be safe.

There seems to be a good correlation between the lime requirement figures found from the laboratory investigations and the field results so that a liming factor can easily be worked out. For Islampur State farm soils the liming factor, as the data in hand reveal, is 1:1.5.

Further investigations are being carried out on the nature of acidity, causes of variations in soil reaction, the exact amounts of lime to be applied to different portions of the farm and the frequency of its application.

25. Problems in the reclamation of waste lands in Bihar. I. Improvement of Leached Acid Sandy Soils.

H. N. MUKHERJEE and S. C. MANDAL, Sabour, Bihar.

A peculiar problem was encoutered while trying to cultivate 4000 acres of waste land in the north-east corner of Bihar, under a rainfall of 125" per year. Though the soil was rich in organic matter and nitrogen, rabi crops failed to grow and kharif crops were poor.

The land consists of thin soil 1′ to 3′ in depth, lying over a deep of strata of fine sand, and shows 5-6% loss in ignition, 0.15—0.20% nitrogen, 0.20% available, P_2O_5, 0.007% available K_2O and 0.06% HCl—soluble calcium. Exchangeable calcium is 1.150, magnesium 0.30 and Hydrogen 7.00 milliequivalents per 100 gram. soil. Water-soluble aluminium is 0.5—1.0, and exchangeable manganese 100—150 parts per million. The surface soils contain about 50-60% of fine sand and 10-20% clay, and have an acid reaction of pH 5.2.

Liming shows good effect on maize but not on paddy, but in both cases soluble nitrogenous and phosphatic fertilisers immediately improve crop growth, inspite of the high N and P content of the soil. Lime requirement studies show that one ton of lime per acre would raise the pH from 5.3 to 6.5, under field conditions. Nitrification studies with different treatment are being done, in order to devise means by which the resistant organic complex could be broken down so as to liberate the reserve nutrients. Studies on the probability of toxicity due to aluminium manganese and organic residues, are also proceeding.

26. Decomposition of Phosphatic Fertilizers and manures.

S. C. SEN, Pusa, Bihar.

It has been observed in the manurial experiments with different doses of nitrogen and phosphoric acid ranging between 0-200 lbs. per acre with or without potassium that the yield and the juice quality were erratic, particularly so, in calcareous soils with superphosphate and ammonium sulphate. A thorough and systematic study with phosphatic fertilisers and manures revealed that (i) the reaction between superphosphate and $CaCo_3$ in hot took place with measureable velocity and was found to be monomolecular; (ii) in the reaction between superphosphate and calcareous soils at room temperature, it was found that water and 1% citric acid soluble phosphoric acid were greatly reduced from 0.025 to 0.001 in 10 days and 0.0003 in 20 days; and from 0.225 to 0.073 in days and 0.063 in 20 days respectively. These phosphates were, however, again increased to an extent of 6 and 50 percent respectively. Total phosphoric acid in calcareous soils and total water soluble and 1% citric acid soluble phosphoric acid in non-calcareous soils remained unreacted; (iii) No reaction with **bone meal** was found in non-calcareous soils whereas, in calcareous soils a slight increase in both water and 1% citric acid soluble phosphoric acid was observed; (iv) the phosphate content of **niciphos** and **ammophos** fertilisers in calcareous soils remained unreacted in cold but 80 percent of the ammonical—nitrogen of these fertilisers was decomposed and 20 percent of them was nitrified.

27. Phosphate manuring of legumes—its influence on Nitrogen Fixation and on the yield of succeeding crop of cereal.

B. V. VENKATA RAO and S. V. GOVINDARAJAN, Bangalore.

It has been recognised for some time that manuring leguminous crops with phosphates benefits the crops through adequate nutrition of the nodular organisms associated with such plants. Legumes being strong feeders on phosphates are also known to utilise these fertilizers fully and on being turned into soil release the absorbed phosphates through gradual mineralization to the benefit of succeeding crops.

A large number of experiments conducted in pots, plots and on Government experimental farms in Mysore State, over a number of years on the influence of (i) application of phosphates to green manures like **Crotalaria juncia, Dolichos biflorus** and **Vigna catiang,** preceding cereals like paddy and Ragi and (ii) on the yield and protein and phosphorus content of legumes themselves when grown to maturity have shown that there are not only increases in the yield and nitrogen content of green manures grown with phosphate but also increases in the yield of paddy and Ragi following them. The amounts of Nitrogen and Phosphoric acid recovered in the cereal are also considerably increased indicating better utilization of the phosphate.

28. Phosphatic fertilization of Berseem (Trifolium Alexandrium) influence of boron and Molybdenum.

N. P. DATTA and H. GURUBASAVARAJ, New Delhi.

A field experiment with berseem fodder crop was carried out for two seasons during rabi 1949-50 and rabi 1950-51 on a loamy soil at the Indian Agricultural Research Institute Farm at New Delhi to test the effect of two micronutrient elements namely, boron and molybdenum in conjunction with phosphates. The major element treatments consisted of superphosphate, rock phosphate ground to pass through a 100 mesh sieve, and ammonium phosphate, all to supply 80 lbs. of P_2O_5 per acre, and ammonium sulphate to supply as much nitrogen as contained in the quantity of ammonium phosphate used, and a control. The micronutrient element treatments consisted of boron to supply 5 lbs. of borax per acre, molybdenum to supply 1 lb. of molybdic oxide per acre, as sodium molybdate, a combination of the two elements at the same rates, and a control. The design was "Split-plot" with 4 replications and had 80 plots with a net plot size of 1/62 acre. The results showed that both boron and molybdenum exercised a significant influence on nodulation, fodder, seed and **bhusa** yields of berseem. Also that as crop removal from the soil increased, the effects of the applied micro-nutrients became more significant.

The possibility of using boron and molybdenum as fertilizers in conjunction with phosphates to obtain increased yields of leguminous fodder and seed on soil types similar to those of Delhi appears thus indicated.

29. Soils of Damodar Valley. I: Soils of Barhi area: Relation between clay content and nutrient status of closely lying areas.

J. N. CHAKRABORTY, M. K. MUKHERJEE and G. S. ROY, Hazaribagh, Bihar.

Barhi area of Hazaribagh district lies in the Hazaribagh Kodarma plateau in Chotanagpur Range. These lands are undulating and subject to erosion. In the process of erosion, the clay particles move. It was observed previously that nutrients in the same profile move along with the movement of clay. Whether this is applicable in cases of eroses has been tested.

For this surface samples from various contiguous sites of each locality are examined simultaneously. Samples from 4 localities have been analysed and studied. In each case, if the soil with the highest organic matter content is taken as the soil least eroded, and the clay content of its usual clay content of the particular area, it may be taken that the soils which are richer in clay have gained and those which are poorer in clay have lost due to erosion. Movement of nutrients have occurred. There have been losses in eroded ones but accumulation have not occurred with the accumulation of clay.

30. Soils of Damodar Valley: III—Phosphate studies: Factors responsible for Fixation of Phosphates.

J. N. CHAKRABORTY, M. K. MUKHERJEE, and G. S. RAY, Hazaribagh, Bihar.

The influence of the following factors (i) the colloidal fraction of the soils (i.e. clay and clay & silt fractions), (ii) The sesquioxides, (iii) the total and exchangeable and (iv) pH were studied in the case of soils belonging to different but contiguous villages in the phenomenon of fixation of phosphates determined (i) by keeping the soil phosphate solution in contact for different periods of time and dissolving the soluble phosphates with water followed by seminormal acetic acid and Truog's reagent consecutively and (ii) by studying the maximum amount of P fixed by the method developed by Mukherjee and by taking with the values before and after removal of soluble P.

It was found that there is a good degree of correlation with percent clay, in all the methods of fixation of phosphates showing thereby soil colloids besides sesquioxides exert an important influende in the amount of P fixed in soils occuring in the near about areas.

31. The comparative effect of F. Y. M. and cane trash compost as source of organic matter on the availability of phosphates in calcareous soils of Pusa.

P. K. ROY, Pusa, Bihar.

An investigation into the comparative effect of F. Y. M. and cane trash compost on the availability of phosphates measured by 1% Potassium carbonate extraction in the calcareous soils at Pusa was undertaken under optimum moisture and temperature conditions. An increased availability was observed in the first fort-night both in the F. Y. M. and cane trash compost treatments at two levels (25:1) and (25:2). Thereafter F. Y. M. in the two proportions continued to show gradual increase upto 56 days, whereas cane trash compost in the same proportions under the same conditions of moisture and temperature showed gradual decrease in availability with the time of incubation upto 56 days.

Thus F. Y. M. as source of organic matter incorporated in calcareous soil augments the availability of phosphate, on the contrary cane trash compost which when admixed decreases its availability.

32. Canning of curried vegetables.

NAGINA LAL JAIN, BALDEV SINGH BHATIA and GIRDHARI LAL, Mysore.

Canned curried vegetables, ile. 'ready to serve' type of cooked vegetables packed in cans, are in great demand by the Ministry of Defence, for the army. Experiments have, therefore, been conducted, as a result of which recipes and methods for the preparation and packing of potatoes, tomatoes, peas and cauliflower, in five different combinations, have been standardised. The vegetables after preparation (as for coooking in the homes) are packed raw in the cans; and fat, spices, water etc., are added in the form of hot gravy. The proportionate amounts of vegetables and gravy have been determined to get the desired head space and net weight of contents in the final packs. The filled cans are exhausted and processed as usual, followed by cooling. An exhaust of 5 to 6 minutes (for 2½ cans) in boiling water in a stationery kettle, which raised the temperature in the centre of the can to 175-180°F, has been found to give a reasonable vacuum of 12-16″. With regard to processing, a time of 1 to 1¼ hr. at 10 lbs. steam pressure (at sea level), gave satisfactory results in so far as incubation tests carried out for 2 weeks at 50°C., did not reveal any spoilage in packs processed under these conditions. The results with slight modifications in the recipes, are applicable to other vegetables and their combinations also.

33. On the quality of groundnut oil.

U. P. BASU, M. SEN GUPTA and N. DE SIRCAR, Calcutta

Groundnut oil was made from seleted nuts by **ghani** run by an electric motor and separated in fractons. By this process a fraction can be obtained to afford and oil of low acid and peroxide value, containing an higher amount of tocopherol and showing a lower color index. This fraction is suitable for preparations where a high grade oil is required. The other fractions can be used as usual for commercial purpose.

34. The relation between the yield and the nutritive value of wheat.

G. C. ESH and U. P. BASU, Calcutta.

A sample of wheat was collected from a crop which was grown with an unusually high yield (37 mds./acre) in the bungalow of Hon'ble Sri K. M. Munshi, Minister of Food and Agriculture. Government of India. The nutritive value of this sample has been compared with an average wheat in order to find whether or not a high productivity results in a higher nutrient level. The chemical composition of the test sample tends to contain a little more protein and calcium but a little less phosphorus. thiamin content has been found almost the same. Thus the concentration of different nutrients has not been significantly changed. The total out-turn of nutrients per unit of land is, however, higher due to the higher yield of the crop. The biological assay shows that the protein utilization or the protein quality has not been significantly changed due to high productivity.

35. Studies in gur quality in Bihar—1.

K. L. KHANNA and A. S. CHACRAVARTI, Pussa, Bihar.

Traditional differences in reputation exist between different gur manufacturing areas in respect of quality of their products and those originating from reputed centres easily command a premium in sale markets. To estimate correctly the extent of actual zonal variation and to assess the veracity of popular reputation, it is essential to undertake a detailed analytical examination of quality, as obtained in different manufacturing centres. The present investigations constitute a preliminary attempt in this direction with reference to the Province of Bihar.

Products from different areas in the Province have been examined in detail with regard to general features as also important physical and chemical criteria, viz. Polarisastion, invert sugar, moisture ash, colloids, acidity, colour, pore space (for solid products only), insoluble impurities and phosphate contents.

A provisional system of gradation has been worked out, consisting in the allocation of points in respect of different criteria, the average points secured (i.e. Total points/no. of factors) determining the grade. Division has been effected into four grades (A1, A2, B and C) on the basis of prescribed ranges for average points secured. A classification from the Refinery stand point (on Nett Rendements) has also been made, which closely follows the gradation on a combined assessment of all quality factors.

The studies bring out a wide margin of variation for all properties and reveal the rarity of A_1 and A_2 as against the preponderance of B and C grades. They also establish the unreliability of popular reputation in many cases, thus pointing to the importance of analytical gradation. Certain comparisons are drawn between Bihar products and those from renowned U. P. markets the latter coming under B grade on an over-all estimate, although superior in respect of colour.

An examination of the quality of Palm gur samples made in Bihar establishes their parity with the best of sugarcane products.

36. Studies in storage of gur—III.

A. S. CHACRAVARTI, SATRUGHAN PRASAD, DURGA PRASAD SRIVASTAVA and K. L. KHANNA, Pusa, Bihar.

The studies represent a continuation of the work of Khanna and Chacravarti on the problem of storage of gur, undertaken with a view to developing such easy, effective and economic methods as would find ready and universal adoption among stockists of gur in the country. As a result of detailed experimentation, several improvements and modifications have been effected in respect of moisture-proof wrapping materials and containers which combine simplicity with a minimum of expense, viz. (1) Modified methods of storage in paraffin wax coated paper (a) Large bags of waxed paper built up on wooden platform, (b) large dealwood box with a lining of paraffin wax coated paper. (2) Moisture proof gunny bags and hessian (a) "Alkathene" bags, (b) a special type of method has been successfully evolved which suggests excellent possibilities with regard to special moisture-proof godowns for gur storage, viz. (3) Storage in brick reservoir lined with tar-felt.

Each of the above methods maintain the product intact in respect of quality as well as quantity all through the period of storage Economics of the different methods have been worked out which reveal a financial advantage of the order of Rs. 7/- per maund of gur stored, as compared to the usual method of storing blocks stitched in ordinary hessian.

Preliminary trials on the cold storage of gur reveal outstanding results, thus bringing out the need for large scale trials on a commercial basis so as to explore its potential utility.

37. Preliminary observation on the packing of orange juice.

N. L. JAIN, D. P. DAS and KIRDHARI Lal, Mysore.

Orange juice packed by the ordinary methods of processing is known to undergo deterioration in quality during storage, due to development of typical 'off' flavours and loss of normal pleasant odour and aroma. This type of change have been experienced to be more pronounced in the juice of loose jacket oranges. Although, general quality and maturity of the fruit, etc., play an important role in determining the quality of juice and its behaviour during storage, yet there are other factors also responsible for the same. Peel oil and oxidation changes have been considered to play an important role in these changes. It has been reported in the literature on the subject that recoverable peel oil itself is not responsible for deterioration of the juice but some reaction is believed to take place between the peel oil and a steam volatile substance present in the juice, which produces the undesirable changes.

Experiments were undertaken in the former Indian Institute of Fruit Technology (merged with the Central Food Technological Research Institute in 1950) to investigate the cause of the above type of deterioration in orange juice and to find out ways and means to avoid or minimise the same. Results of preliminary experiments carried out with Nagpuri Sangtras have shown that controlled boiling of the juice for about 3 minutes and removal of the scum formed, followed by immediate cooling and packing as usual, helps considerably in the retention of normal pleasant flavour of the fresh juice. The addition of steam distillate fraction of the juice or peel oil emulsion, however, impaired the quality of the normal juice.

Further work on this problem is in progress in these laboratories, with Coorg oranges.

38. Utilization of waste lime pulp.

N. L. JAIN, D. P. DAS and GIRDHARI LAL, Mysore.

Citrus residues left after juice extraction are widely used for recovering oil, pectin, etc. but no attempt seems to have been made for the utilization of pulp left over in the clarification of lime juice for cordial making in this country. Large quantites of such waste pulp available in factories preparing lime cordial offered great difficulty in its disposal; it had to be discarded and thrown down the drains. In investigations carried out for the economic disposal of this pulp, it ha been found to contain varying proportions of lime oil depending upon the quality of fruit, locality grown, methods of juice extraction and sedimentation as also separation and recovery of clear juice, etc. This oil content of the various samples of pulp tested was found to range between 0.8 and 4.0%. In one lot, 67 gallons of pulp yielded about 20 lbs. of oil. This oil has been successfully recovered at a normal cost by the usual method of steam distillation. But for its slightly low citral content, the quality of the oil compares favourably with the steam distilled oil of the fruit peels. The oil has been found to be suitable as a flavouring material for lime squash, without imparting any terpenous odour to the product during storage test carried out over a period of one year.

The pulp also contains another important constituent of the juice viz. citric acid. A fair proportion of this, in the form of juice diluted with water could be successfully recovered before steam distillation of the pulp for the recovery of oils. This could be used in the preparation of cordial. From the residue left after steam distillation a clear liquid was obtained which was also found to be quite suitable for mixing with pure juice, in the preparation of cordial. This liquid could also be used for the recovery of citric acid in the form of Calcium and alkali citrates.

39. Control of mango hopper in Bihar.

R. S. ROY and K. B. RAM, Sabour, Bihar.

The study of mango hopper was first taken up at the Fruit Research station, Sabour in 1945-46 and continued till 1949-50. The attack of the pest is most severe on tender shoots, inflorences and very young fruits which wither and consequently the fruits either do not set at all or drop down prematurely. The insect excretes sweet sticky substance which falls on leaves and imparts a shining appearance to them. This substance is said to kill the flowers after the development of sooty mould which blackens the entire foliage and checks greatly the photosynthetic activity. Fazli mango a late variety is more susceptible than Bombai and Langra varieties. The damage done to inflorescence may range from 20% to almost 100%, and the mango crop may be an utter failure in severe infestation. Spraying and dusting trials were, therefore, undertaken to study the effect of various insecticides viz. soap-nut decoction, sulphur, gammexane at different formulations, guesarol and Ioline (both D. D. T. products), Hexaclan and Kitkari dust. Almost every treatment was effective without being toxic to the host plant but the best results were obtained with fuesarol 550, one lb. in 40 gallons of water, using 6-7 gallons of the solution per tree, application being made at the flower-bud differentiation stage. These results were tested on a large field scale both during 1949-50 and 1950-51, spraying 1100 and 26000 trees respectively at a subsidised cost to the cultivator of annas four and annas eight per tree during the two years. The actual spraying costs worked out to Rs. 1/12/- per tree. It is pointed out that this plant protection measure benefitted the State of Bihar to the exetnt of Rs. 6 lacs last year assuming that 50% of the crop was saved and the price of the fruit was Rs. 8 per hundred. Control of the entire crop (some 20 lakh trees) would bring a return of some Rs. 5 crores.

40. On the control of paddy hispa.

S. D. AGGARWALA, Pusa, Bihar.

Paddy hispa (Hispa armigera) is a very serious pest of paddy in certain parts of Bihar. About 25,000 acres are involved and the loss in such affected areas may be safely put as 50%. Experimental work was, therefore, undertaken with a view to find out suitable control measures. A field trial was laid out in the usual randomized fashion with four replications leaving a sufficiently wide border around each plot, the net size of which was 1/40th acre. The treatments consisted of (i) 0.5% BHC (gammexane p. 520), 0.25% BHC, 0.1% BHC, 0.25% DDT, 0.10% DDT each with and without cutting of top leaves 4″ above water, grazing by pigs as practised by local farmers and no treatment control. The paths were also treated half with the same treatment as given to plot adjacent to them.

Percentage drop in the population of Hispa after treatment was more than in control in all treatments except for grazing of pigs. This drop was highly significant in the case of 0.5% and 0.25% BHC with or without cutting of top leaves and significant for 0.1% DDT. There was an increase in the yield of paddy and straw also in all treatments in the same order as above. This was 2 to 3 times more than in control. The net gain to the farmer was 45/9/- in the treatment 0.25% BHC alone; @ Rs. 12/8/- per maund of paddy and Re. 1/- per md. of straw. The net gains in other cases varied from Rs. 14 to Rs. 31/-.

41. Precis orithya as a controlling agent for Striga euphrasioides; a root parasitic weed on sugarcane.

S. D. AGARWALA and S. Z. HAIDAR, Pusa, Bihar.

Precis orithya, Swinhoe, commonly known as "Blue Pansy" has been recorded from all over the Bihar State. Its caterpillars have been observed feeding on **Striga eupharasioides,** a serious root parasite of sugarcane and some other weeds. The investigations conducted were aimed to study this possibly beneficial insect in detail and to assess its utility in controlling Striga. As such the life-history, bionomics, morphology, natural parasites and starvation-tests have been studied under laboratory as well as field conditions at the Central Sugarcane Research Station, Pusa, Bihar for the past 2 years.

In Laboratory, the insect was reared on **Justicia quinqueangularis** (Koen) and the total average life-history of the insect has been observed to be 27-29 days The insect, though observed all the year round is abundant only during August to October. Starvation tests showed that the caterpillars preferred to starve rather than to feed on sugarcane, maize, paddy, Arhar, Jute, Sann-hemp and a few other saccharum sp. A Hymenopterous parasite from the caterpillars and a Dipterous parasite, the maggots of which come out from the pupae, and pupate outside have been recorded and are under identification.

42. Hydrophobic colloidal sulphur spray for wheat rust control.

M. L. GATTANI.

Efficacy of hydrophobic colloidal sulphur spray was tested by the author for the control of wheat rusts. In the laboratory 1:50,000 dilution of the spray fungicide inhibited germination of the urediospores and 1:100,000 dilution induced lysis of the germ tubes of the urediospores of black and brown rusts. In yellow rust 1:500,000 dilution inhibited urediospore germination and 1:1,000,000 dilution induced lysis of the spores.

In green house tests 1 percent of the sprayed plants showed rust infection whereas in the control plants rust infection was almost 100 percent. Field experiments were conducted during 1950-51 at Basi Farm, Rajasthan to test the relative efficacy of sulphur dust and the hydrophobic colloidal sulphur spray for the control of wheat rusts. The year under review was relatively a rust free year and there was no infection of the wheat crop with the rusts till February. In March the dusted, treated and untreated crop showed 5,5 and 15 percent rust infection respectively. The increase in yield as the result of spraying and dusting was 4.5 and 1 percent respectively, over the control. The actual cost of the chemicals for one spray operation was four annas per acre as compared to Rs. 7/8/- per acre for one dusting operation.

It, therefore, is indicated from the results so far obtained that spraying with hydrophobic colloidal sulphur might prove as a good and cheap substitute for sulphur dusting for the control of wheat rusts.

43. Wilt Disease of Cane.

S. A. RAFEY. Pussa, Bihar.

The fungus causing the Wilt disease was first recorded in 1906 as a weak parasite. During the red rot epidemic in 1939-40 it was found associated with red rot and it hastened the deterioration of cane. Large number of varieties were affected, with incidence ranging from 5 to 25%. In mill tests the drop in sugar recovery was pronounced being 34% for an incidence of 40%. Against the estimated recovery of 11.25% to 12.89% in healthy canes that for wilted canes was 2.18% to 4.71%. The wilted canes lost in height by about 30% and in weight by about 50% compared to healthy ones.

Both **Cephalosporium** sacchari and Fusarium moniliforme have been found in cultures obtained from wilted canes but their use in reinnoculation showed that only the former could produce typical wilt symptoms. It is concluded that these are alternative forms of the same fungus the former causing the diseases and the latter assisting to form later symptoms such as cavity formation etc. However, innoculations tests carried out at several centres in the State showed much variation due to soil and seasonal factors. In most cases these symptoms consisted mainly of yellowing of leaves without shrinkage of cane rind or complete drying up.. Successful reproduction of the disease was obtained when setts were planted in soil innoculated with culture of C. **sacchari** and its reapplication again when the crop was six months old. Sandy soil and light irrigation favour the infection whereas a lowering of pH below 7 and of the temperature by 5-7°F inhibit it. The disease appears to be kept in partial check due to competition with other soil microbes during the early season and its incidence increases from September onwards. In nature the mode of infection appears to be due to spurting of infected soils on to stem lessions.

44. Preliminary experiments on the control of Calandra Oryzae. Linn (rice weevil) infesting wheat at Pusa (North Bihar) 1949.

S. B. D. AGARWALA, Pusa, Buhar.

Laboratory experiments were conducted with different doses of D. D. T. and B.H.C. (gammexane D.025). For this purpose ordinary cloth bags were made each containing one Kilogram (1000 gm.) of wheat from which all store-pests had been removed. Twenty five adults of Calandra oryzae collected from the local farm were introduced in each bag and each was securely tied at the top. These bags were then placed in a packing case each separated from its neighbour by a four inch space tightly packed with good 'Bhusa' the lid of this box was fastened with nails firmly on 23.7.49. The grains at this time contained 8% moisture. The box and the containing bag remained undisturbed in a room for eighty days when they were opened on 8.10.49. Insects dead or alive were collected and counted separately.

Percentage of loss in weight during this storage by actual weight of each lot and the % of grains attacked was calculated from a sample of 50 grains from each lot.

All the treatments were significantly better than control even at 99:1 odds so far as their effect in preventing damage to grains and loss in weight is concerned. The same results were obtained as regards the mortality of the weevils, except the one in which I part per million of D. D. T. was mixed. Again of all these treatments the four higher doses of gammexane and the three higher doses of D. D. T. proved very efficacious in preventing the losses. Gammexane treatments were better than D. D. T. treatments but imparted foul smell to the grain which was objectionable if the grains was meant for human consumption.

The net profit worked out to Rs. 370/- to Rs. 630/- per thousand maunds stored. Judging from all these points recommendable doses are B. H. C. (gammexane D.025, 10 parts of gammaisomer per million parts of wheat) or if meant for human consumption D. D. T. 100 parts per million parts of wheat.

45. Annotated list of crop pests in the state of Orissa.

G. C. SENGUPTA and B. K. BEHURA, Cuttack.

A list of crop pests of Orissa together with short notes on their life history is given. The lists of pests have been arranged under crop heads for ready references.

46. A new report of a rust (Puccini Kuennil Kreug) Butler on Erianthus munja

S. L. SHARMA, Pussa Bihar.

This is the first report of occurrence of a rust, and for the matter of that, of a fungus on Erianthus munja. The size of its spores and successful cross-inoculation on Erianthus arundinaceum with this rust and on Erianthus munja with Puccinia Kuehnii (Krueg). Butler, found on the former left no doubt as to its identity. It is none other than P. Kuehnii (Kueg) Butler, known to occur on wild Saccharums. Differential behaviour of various forms of both the species to this rust has been recorded and is under further investigations.

47. Frog eye spot disease of tobacco.

N. PRASAD and C. C. SHAH, Anand.

Frog's eye spot has been considered to be of little economic importance. An epidemic appeared in 1950 at the Agricultural Institute, Anand and the loss was considered to be heavy. Nitrogen and nicotine percentage were estimated and there seems to be a direct relationship between the nicotine percentage and quality of tobacco.

Evaluation of the crop by tobacco merchants confirmed the estimate of loss on the basis of reduction in nicotine percentage.

48. Alternate Host Plants of the Cutworm Pest (Agrotis ypsilon Rott.) In the Plains of Bihar.

A. C. SEN, (Sabour, Bihar).

Although the *Agrotis ypsilon* Rott., has been a serious pest in Bihar on the winter crops since a long time, its annual appearance and disappearance had remained a matter of speculation until now. As a result of studies for the last 5 years, it has been found that the pest can successfully complete its life-cycle during the summer months on a number of alternate host-plants which exist as weeds during that period (*Sen, Jour. Sci. & Tech*, 1949).

Further observations are in progress to study the life-history of the pest under natural conditions on the alternate hosts and to find out the controlling effects of insecticidal treatments of these weeds on the spread of the pest to the winter crops.

39th INDIAN SCIENCE CONGRESS, CALCUTTA, 1952

SECTION OF ZOOLOGY & ENTOMOLOGY

President : Prof. B. R. SESHACHAR, D.Sc., F.Z.S.,

Abstracts

CYTOLOGY

1. A new method for the study of the chromosomes of grasshoppers by the electron microscope.

S. P. RAY-CHAUDHURI, N. N. DAS GUPTA and A. GUHA, Calcutta.

A modification of the squash technique of light microscopy has been devised for the study of the early spermatocyte chromosomes of grasshoppers by the electron microscope. Squash preparations were made on collodion coated slides and favourable regions of the film were subsequently stripped off on water for mounting on specimen grids of the electron microscope. This method has been found to be superior, for our purpose, to the following methods: (i) cutting ultra thin sections (*ca* 0.2) developed by Pease and Baker, (ii) making squash preparations on glass slides and subsequently transferring the chromosomes on collodion film as suggested by Schultz *et al*, and (iii) crushing the testes in mortar and pestle with gravel sand and repeatedly centrifuging before finally putting a drop of the sediment on the collodion coated grid (modified Claude and Potters method). Electron micrographs of meiotic chromosomes were taken by using all the above methods and a critical examination of the different photographs revealed that the delicate structure of the chromosomes is more or less well preserved in all of them but our method seemingly gave consistently better micrographs.

2. Frenquency of anaphase bridges in the grasshopper. *Gesonia punctifrons* at different intervals after X-radiation.

S. P. RAY-CHAUDHURI and IRA SARKAR, Calcutta.

Two experiments have been designed by us to determine the effect of X-rays on the meiotic chromosomes of the grasshopper, at different intervals of time after irradiation. The dosage given varied from 40r to 320r and the material was fixed at short intervals of time, from 6 hours to 148 hours after irradiation.

From a calculation of the frequency of dicentric bridges, observed at first anaphase of meiosis, it was found that throughout this long period of time extending up to 148 hours, the frequency remains constant and the slight deviations observed are not statistically significant.

It is therefore concluded that the chromosome is broken at the resting stage, long before the time of splitting into daughter chromosomes; the two broken ends then manage to remain as such till the duplication of chromosomes after which the four resulting broken ends take part in structural changes giving rise to dicentric bridges at anaphase I.

3. A study on the chromosomes during spermatogenesis in two spiders *Hersilia savygni* and *Stegodyphus sarasinorum.*

S. P. RAY-CHAUDHURI and B. N. BOLE GOWDA, Calcutta.

The present paper records the number, morphology and behaviour of chromosomes, particularly with reference to the X-chromosome during meiosis in the males of *H. savygni* and *S. sarasinorum*, representatives of Hersiliidae and Eresidae respectively. Karyological study of these two families is reported here for the first time.

Hersilia savygni possesses 30 acrocentric chromosomes which comprise 14 homologous pairs and one dissimilar pair, the latter constitutes the X_1 and X_2 chromosomes. The larger of the two X-chromosomes (X_1) is nearly twice as large as the biggest autosomes and the smaller one (X_2) is nearly one fourth of the larger X. Because of the unusually large size of the X_1 chromosome it can be distinguished very clearly in all stages of mitosis and meiosis. There is no resting period before the second meiotic division and in metaphase II two kinds of plates one having 14 and the other 16 are found in equal numbers.

Stegodyphus sarasinorum shows 30 acrocentric chromosomes on the spermatogonial metaphase plates of which 28 are autosomes and two sex chromosomes but, unlike the former species, the X is not distinguishable from the autosomes during the spermatogonial divisions. They however, become conspicuous by their positive heteropycnosis during the prophase stages of meiosis.

4. Further evidences on the occurrence of X0 mechanism of sex determination in spiders.

S. P. RAY-CHAUDHURI and B. N. BOLE GOWDA, Calcutta.

The male spiders in general are characterised karyologically by $X_1 X_2 0$ type of sex chromosome complex. The X0 and $X_1X_2X_3$ types are sporadically observed only in a few families. The present paper records the occurrence of X0 type of sex mechanism in the males of four other species of spiders belonging to two families Oxyopidae and Salticidae.

Oxopes similaris (Oxyopidae), like other species of *Oxyopes* so far investigated, has 10 pairs of acrocentric autosomes and a single X-chromosome. The latter cannot be identified during the spermatogonial division, but in the spermatocytes, both in the resting as well as in the prophase nuclei, it is positively heteropycnotic and therefore clearly recognizable. The first meiotic division is reductional for the X chromosome and as a consequence we have two kinds of second division metaphase plates one with 10 and the other with 11 chromosomes.

All the three species of *Myrmarachne (M. lactus, M. providens,* and *M. ramunni)* belonging to Salticidae have 23 acrocentric chromosomes in the spermatogonial plates, that is two more than what is present in *O. similaris.* The behaviour of the X-chromosome and the general course of meiosis are very similar to those of the above species. Two types of second division metaphase plates are found in all the three species one with 11 and other with 12 chromosomes; the latter includes the single X-chromosome.

5. Polyploidy in the Spermatocytes of some Acridids.

M. K. DUTT, Delhi.

Quite a number of polyploid cells at both 1st and 2nd spermatocytes have been found in *Oedaleus* and *Trilophidia.* In *Acrotylus,* however, polyploidy has been observed only in some of the 2nd spermatocyte nuclei. Polyploid 2nd anaphase stage has been found in *Oedaleus* and *Trilophidia.* Since there is no multiple chromosome association, although the mean chiasma frequency per long bivalent in *Oedaleus* and *Trilophidia* is 2.48 and 4.00 respectively, it is believed that these polyploid cells have originated due to fusion of nuclei in a syndiploid tissue prior to metaphase I, when the nuclear membrane is dissolved. The possibility of getting individuals with higher chromosome numbers than the normal diploid number of 23 in these genera, has been discussed in the paper.

6. Occurrence of Polyploidy in Scorpions.

C. B. VENKATANARASIMIYA, Bangalore.

It is a well known fact that polyploidy, though common in plants, is a rare phenomenon among animals. The occurrence of polyploidy, particularly in bisexual forms, would be very interesting as (1) the significance of its presence in bisexual forms is doubtful and (2) it may upset the sex mechanism. Polyploidy, however, has been recorded in some animals like: *Paludestrina jenkinsi* (Peacock 1940); *Mesostoma* (Valkanoy 1938, Ruebush 1938). Slack (1938a) has suggested the occurrence of polyploidy in Heteroptera.

The study of chromosomal number in two scorpions, *Palamnaeus vimanus* (Pocock) and *P. swammerdami* (Simon) has revealed the presence of polyploid condition in the peripheral cells of the testes. In the case of *Palamnaeus gravimanus* the number of chromosomes 56, 112 and 224 were noticed and in *P. swammerdami* 32, 64 and 128 were seen. These numbers recorded in two species clearly indicate that there is the occurrence of polyploidy among the scorpions, a feature which lends full support to previous observations of Piza (1940) on *Tityus bahiensis.*

The striking difference in the chromosomal number in the two closely allied species, particularly found in the same locality, is also of great interest.

White (1948) has reported wide range of chromosomal number in the Scorpions, which varies from 6 in *T. bahiensis* (Piza 1939a, 1940a), 12 in *T. serrulatus,* 24 in *Buthus martensii* to 24 in *B. acute carinatus* (Nath).

The origin as well as significance of this phenomenon is being studied.

7. Multipolar division in *Laccotrephes maculata* Fabr.

C. M. S. DASS, Bangalore.

While examining the history of chromosomes during spermatogenesis of *Laccotrephes maculata* (Fam: Nepidae, Hemiptera: Heteroptera), the author came across two cases of multipolar divisions. In one case there were 12 poles and in the other 8 poles. Both cells were in the I meiotic metaphase. It was not possible to make the exact count of the chromosomes; however, there were more than the diploid number (2n=43). It is believed that they have arisen by an arrest in the anaphase movement, and the formation of 'Restitution' nucleus. The precocity of the centrioles, a feature characteristic of the species, causes an improper nucleination of chromosomes and is responsible for their arrest in movement to the poles during anaphase. The author has discussed the method by which the two cases have arisen from a normal spermatogonial cell.

PROTOZOOLOGY

8. Some recent Foraminifera and other organic remains from the shore-sand of Bombay.

A. CHAUDHURI and B. BISWAS, Calcutta.

Studies of recent microscopic marine organisms are comparatively new in India, and more particularly of the smaller foraminifera, bryozoa, ostracoda, alcyonarian coral sclerodermites and ontogenetic forms of larger animal remains, etc. The present paper deals with such above remains collected from Juhu, Bombay.

9. On a new Flagellate parasite from the gut of a Pentatomid Bug *Dydescus* sp.

P. N. GANAPATI, Waltair.

The paper deals with the morphology and development of a new *Crithidia* found parasitic in the intestine of a common pentatomid bug feeding on the juice of the Euphorbiacious plant *Croton sparsiflorus*. While the adult bugs show only moderate infection the nymphs are generally heavily infected. The flagellates increase in number both by binary and multiple fission. 'Rosette' formation is characteristic of the species.

A review of our present knowledge regarding the flagellate parasites in insects is given at the end of the paper.

10. On a new Coccidium *Eimeria sphenocercae* n.sp., from *Sphenocercus sphenurus* (Kokla green pigeon).

D. K. RAY, Mukteswar.

A coccidium of the genus *Eimeria* has been described for the first time from the avian host *Sphenocercus sphenurus* commonly known as Kokla green pigeon which was shot at Mukteswar (altitude, 7,500 ft. above sea level). The specific name has been kept after the generic title of the host as *Eimeria sphenocercae*. n.sp.

The oocyst is double contoured. It is typically kidney-shaped with a slight dent on one side. The size of the oocyst varies from 25.0 μ to 17.5 μ in length and 15.0 μ to 12.5 μ in width, the average being 19.18 μ × 12.61 μ. The oocyst is surrounded by an exomembrane which is tight fitting all over the body except at either poles where it broadens considerably in the form of an irregular cap. The micropyle is asymetrical in position and appears as a protuberance. In some cases a plug like structure is seen to close the opening of the micropyle. This becomes more evident when oocysts are treated with Lugol's iodine solution. There is no oocystic residue; sporocysts are broadly oval in outline measuring 18.75 μ in length and 17.5 μ in width, the average being 17.5 μ × 12.5 μ. Sporocystic residue is present.

11. A Study on some Coccidia of Himalayan birds.

D. K. RAY, G. A. SHIVANI, Miss. M. OOMMEN and R. BHASKARAN, Mukteswar.

The paper deals with some coccidia found among the Himalayan crows and birds found at Mukteswar (altitude 7,500 feet). This is the first time that coccidia have been described from these avian hosts. All the coccidia described belong to the Family Eimeriidae. Genus *Isospora*. Five new species of *Isospora* have been described: (I) *Isospora corviae* n.sp. from the common Himalayan crow, *Corvus levaillenti intermedius*. This *Isospora* differs in certain respects from the *Isospora* from the crow described by Yakimoff (1936, 1938) and Sjobring (1897) and hence the creation of the new species. (II) *Isospora cryptolophae* n.sp. from *Cryptolopha xanthoschista* commonly known as Hodgson's Grey-headed fly-catcher. The oocyst averages 24.81 μ × 23.28 μ. It has a double contour and a micropyle. Sporocyst has a cap like structure and it averages 14.21 μ × 10.3 μ (III) *Isospora* sp. from a bird commonly known in vernacular as Mushia. The generic and specific name of the bird is not available, so it has been described as *Isospora* sp. The oocyst has a dobule contour,—averages 20.62 μ × 19.75 μ Brownish in colour. Stida body in the sporocyst is in the form of a black mass. Sporocyst averages 13.40 μ × 8.5 μ (IV) *Isospora garrulae* n.sp. from *Garrulus bispecularis* commonly known as Himalayan jay. The oocyst has a double contour—grayish in colour. Micropyle presents in the form of an elevation of the endocystic wall. The oocysts average 25.20 μ × 21.20 μ. The sporocysts have a cap-like structure,—stida body present. It averages 16.07 μ × 9.60 μ. (V) *Isospora lophophanae* n.sp. from *Lophophanes dichrous* commonly known as brown crested fit. The oocyst has a double contour. It averages 24.16 μ × 20.83 μ Micropyle is in the form of a depression of the endcystic wall. Oocystic residue present in the form of one or two spherical masses.

The sporocyst is piriform with blunt or flattened anterior end. Stida body is in the form of a plug. The sporocyst averages 15. 0 μ × 10. 0 μ

12. On a new coccidium *Eimeria hawkinsi* n.s.. from Indian sheep and goats.

D. K. RAY, Mukteswar.

A new species of *Eimeria* has been described from Indian sheep and goat. From the description of all the valid species of *Eimeria* in sheep and goat, this varied considerably in shape, size, polar cap and micropylar structure. The specific name has been given in honour of Prof. P. A. Hawkins of the Michigan State College, U. S. A.. as *Eimeria hawkinsi*, who confirmed my observation as to its identity as a new species.

The oocysts were first noticed in the faeces of a sheep belonging to this Institute and later on it was found in the material received from Madras and Nagpur. The oocyst was spherical to subspherical in shape. Zygote protoplasm appeared to be scattered in the oocyst and consisted of large number of refringent globules. The oocyst wall had single contour. The endocystic wall was more prominent and dark in colour as compared with the ectocystic wall. The general colour of the oocyst was light grayish pink in daylight. The size of the oocyst ranged from 20 μ to 25 μ in length and 15. 0 μ to 22. 5 μ width, averaging 22. 35 μ x 18. 37 μ. The most interesting feature of the oocyst was the structure of its polar cap and micropyle. The polar cap seemed to be a protruberance of the endocystic wall and its protruded portion had just come out of the endocystic wall in the form of a triangle, the base of which was embedded in the endocystic wall. The micropyle was a very minute gap between the base of the triangle and the endocystic wall.

At 37°C sporalation of these oocysts took place within 10 hours. There was no occystic residue after sporalation. Sporocystic residue was visible. The sporocyst ranged in size from 10. 0 μ to 7. 5 μ in width, the average being 11. 05 μ × 7. 80 μ

13. Observations on the comparative efficiency of Zinc sulphate, Sugar and Salt solutions for the floatation of Coccidial oocysts of sheep & goat.

D. K. RAY, Mukteswar.

To work out the cheapest and the most suitable floating medium for the flotation of coccidial oocyst in sheep and goat three commonly recommended media were given several trials. Keeping always in mind the following factors (1) availability and cheapness of the material (2) high solubility of the material (3) clearer and cooler visual microscopical fields for alleviating eye strain (4) flotation of more oocysts than debris. The specific gravity of all the three media were kept at 1.2.

Zinc sulphate proved to be not suitable for floating the coccidian oocysts of sheep and goat. Sugar though as efficient as salt solution for recovering the oocysts, floats much faecal debris thus hampering the correct count of oocysts. Due to the high refractive index of sugar solution, the oocysts appear shiny under the microscope and strains the eyes. Sugar solution does not crystalise so rapidly as salt or zinc solution, but oocysts kept immersed in sugar solution for some time appear very black and it becomes difficult to recognise them as such. Salt solution on the other hand floats the least amount of debris and gives much clearer and cooler visual microscopical fields. It crystalises very soon—which can be avoided by placing the slide in a moist chamber. It is the cheapest of all the three floating media and easily available as well as highly soluble.

14. *Entamoeba* in cattle.

Miss MARY OOMMEN, Mukteswar,

Mononucleated amoebic cysts belonging to the genus *Entamoeba* were frequently seen in the faeces of cattle. Detailed morphological studies made so far are in agreement with those that are made by Elmer Ray Noble (1950) except that the forms described in this article invariably revealed the presence of iodine vacuoles in their protoplasm. The amoeba has been identified as *Entamceba bovis.*

The cysts were mostly spherical, but ovoid ones were not uncommon. Spherical ones measured 4. 8 μ to 12. 0 μ in diameter with an average of 8. 5 μ while typical oval cyst measured 10.0 μ in length and 0.25 μ in breadth. Noble (1950) found the cysts typically round, ovoid occasionally and they averaged 8. 8 μ in diameter, with a range from 4 to 15 microns. Chromotoid bodies appeared in various sizes and shapes. A large horse-shoe shaped vacuole was invariably present, which stained dark brown with Lugol's iodine. Mackinnon and Dihu (1938) and Noble (1950) found that cysts of *E. bovis* treated with Lugol's iodine showed a vacuole which did not stain with iodine.

The cysts were typically uninucleate, but three out of two hundred cysts were found to be binucleate. Nucleus varied in diameter from 1 to 4 μ with an average of 2. 0 μ. With Noble the average was 3. 0 μ. The nucleus had a thick peripheral chromatin ring with the granules often irregularly distributed. The periendosomal area was not quite distinct. The endosome was conspicious for its large size and appeared to be polymorphic. It measured about 0. 75 to 1. 8 microns in diameter.

A comparative study of entamoebae from domestic ruminants is in progress.

HELMINTHOLOGY

15. Four New species of the genus *Acanthobothrium* from Marine Fishes of Bombay.

F. S. KHAMBATA and D. V. BAL, Bombay.

In our studies on parasites of marine fishes of Bombay. we have recorded several species of cestodes from Elasmobranchs. In this paper, four new species, belonging to the genus *Acanthobothrium.* van Beneden, 1850, from *Rhynchobatus djeddensis*, are discussed. A brief account of all the four species, along with a number of figures, is given.

16. On a morphological study of the genital organs in *Hymenolepis farciminisa.* (Goeze 1782).

L. N. JOHRI, Delhi.

The genus *Hymenolepis* is well known for the constancy of its genital organs in each proglottis of the strobila. Interesting variations in the position of testes are observed in relation to the female genital organs in the same strobila as well as in other strobila in the case of *Hymenolepis farciminosa* (Goeze). A table is incorporated to show the arrangements of the genital organs clearly indicating the variations met with. It is very essential to pay attention to this particular character to avoid unnecessary creation of new species.

17. On a new species of the family Hymenol epididae Fuhrmann (Cestoda) from *Coturnix coturnix* (Linnaeus) from Delhi Province.

L. N. JOHRI, Delhi.

Hymenolepis jassita n.sp. is obtained from *Coturnix coturnix* (Linnaeus) from Delhi Province.

Specific diagnosis :—Maximum length 100 mm. and the greatest breadth 0.316—0.457 mm. Scolex 0.305 mm. long and 0.22 mm. broad. Rostellar sac well developed. Rostellar hooks 10. 103 μ long. Genital pores unilateral. Cirrus sac measures 225—246 μ × 37—47 μ (mature segments) and 314 μ × 47 μ (gravid segments) extending upto aporal excretory vessel and even crossing it. Testes 3, usually in a transverse row. Ovary in close association with two or all the three testes and is disposed transversely. Uterus irregular lobed sac, lateral to excretory vessels with large number of egg-capsules. The eggs and onchospheres measure 21—26 μ and 14—19 μ respectively.

ANNULATA

18. *Haemopis sanguisuga* Linnaeus, the common European Arhynchobdellid Leech compared with *Haemopis indicus* Bhatia, the Indian form of Kashmir.

M. L. BHATIA (Delhi) and K. H. MANN, Reading (England).

Both *Haemopis sanguisuga* and *Haemopis indicus* belong to the order Arhynchobdellae, family Gnathobdellidae, subfamily Hirudininae, and the tribe Distichodonta.

The tribe Distichodonta includes three genera, *Haemopis*, *Myxobdella* and *Whitmania* of which the genus *Haemopis* only is represented in Britain.

Haemopis includes four species:—

Haemopis sanguisuga. Linnaeus,	1758.
Haemopis acranulatum, Whitman,	1886.
Haemopis gracilis. Moore,	1930.
Haemopis indicus, Bhatia,	1940.

The European species *H. sanguisuga* closely resembles the Indian species *H. indicus*. in external features, general morphology and in carnivorous habit, but both differ markedly from *H. acranulatum*, and *H. gracilis*, which occur in Japan and China respectively.

It is interesting to note that *H. medicinalis*. the common medicinal leech of Europe, is not found in the British Isles now. It has become extinct and supplies for medical and educational purposes are every time imported from France, Belgium and other places on the continent. *Haempois sanguisuga,* wrongly named as horse leech, is to-day the commonest leech of the British Isles.

Its systematic position is discussed in the paper.

CRUSTACEA

19. Preservation of semidried Prawns. I. Importance of blanching and brining.

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

As a result of blanching fresh prawns in boiling 4% brine for 2 minutes and during subsequent brining in 25 Be. brine, the bacterial numbers were reduced by 98.42% and 99.45% of the original, respectively. The moisture was reduced by 11.02% and 17.30% respectively. The total volatile basis in the fresh prawns which was 21..00 mg. per 100 g. was reduced to 15.40 and 10.2 mg. respectively, after blanching and brining. The importance of these two processes in the preparation is thus indicated.

20. Preservation of semidried Prawns. II. Use of Ascorbic Acid as a preservative.

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

The effect of use of 0.025%, 0.05% and 0.075% ascorbic acid on keeping quality of semi dried prawns was studied by periodical determinations of bacterial counts, total volatile bases and moisture. 0.025% ascorbic acid encouraged fungal growth even in 4 weeks and did not show any beneficial effect. 0.05% ascorbic acid showed good reduction in bacterial numbers, but developed fungal growth in 6 weeks. 0.075% ascorbic acid also effected reduction in bacterial numbers, but did not enhance keeping quality. The colour faded in 6 weeks and fungal attack also occurred during the same period, and the T.. V. B increased, gradually. In fact the control had better appearance than the ascorbic and treated prawns.

The effect of 'over-drying' or in other words, reduction of moisture to a greater extent *i.e.* 21.72%) had a profound effect on the keeping quality. The bacterial count was throughout low and after 8 weeks it was only 400 per gram. The T. V. B. also was low and fungal attack did not occur even after 8 weeks. The colour was still unaffected. Observations are being continued.

21. Preliminary observations on the rate of growth of the common marine Prawn of the Madras coast, *Penaeus indicus,* Milne Edwards.

S. SADASIVAN, Port Blair.

Of the penaeid prawns, *Penaeus indicus* is the more abundant species on the Madras coast occurring in backwarter, estuaries and lakes where connection with the sea is maintained throughout or part of the year, and in the sea. The paper deals with the attempt to study its rate of growth in backwaters and estuarine regions by statistical methods. The investigation was started in

February, 1948 and was continued upto July, 1949. Periodic collections were made from Pulicat lake, one of the important prawn fishing centres on the Madras coast. Cast net was the only gear employed for collection. Young post larval forms measuring 30 mm. and below made their appearance in August. By October their numbers increased; nearly 36% of the total catch consisted of individuals of this group. The majority size group of 21-30 mm. recorded in the month of October moved to 41-50 mm. group by December registering a growth of 20 mm. in two months and by July next year to 71-80 mm. group. The bimodal form of size frequency distribution indicates the presence of individuals belonging to the previous year group. The growth of these forms is 20 mm. for three months as shown by the movement of the majority size group from 71-80 mm. in August to 91-100 mm. by November. As they reach this commercial size intense fishing activity starts. From this month it is difficult to follow the growth from the size frequency distribution.

Observations on the habits of these forms so far made show that young forms prefer shallow regions where the bottom is muddy and has thick algal growth and as they grow move to deeper regions. They feed on fine particulate matter at the bottom, Harpacticid copepods, other small crustaceans and algal matter. In the laboratory they show cannibalisatic tendencies. The specimens collected in backwater and estuarine regions are found to be immature. The seaward migration is found to occur in April in Pulicat lake.

22. A note on the parasitic Isopod, *Cymothoa eremita* Bruennich.

G. K. KURIYAN, Madras.

Cymothoa eremita Bruennich is the common Isopod parasite on the food fishes of the Gulf of Mannar and Palk Bay. A detailed description of the parasite is given in this paper.

ENTOMOLOGY

23. Complex factors and the behaviour of adult Rice Weevils.

D. BAP REDDY, Hyderabad Dn.

At a relative humidity of 30 per cent in the absence or presence of food, mortality increased as temperatures rose. The survival of the weevil is little influenced by food of lower moisture content, but where it is relatively high it favours longevity. However, at temperatures of 32°C or higher, food exerts little influence upon mortality. Where no food was present weevils lived longer at the lowest temperature and as the temperature increased the survival period became progressively shorter. At each corresponding temperature the weevils lived longer when provided with food. The presence of moisture in the wheat probably accounts for the difference. When the weevils were exposed to 73% relative was present all the weevils died and the mortality rate increased rapidly as the humidity at varying temperatures, very few adults died where food was present, and what mortality occurred, increased as the temperature rose. Where no food temperature rose from 20° to 35°C. Females lived longer than males in the presence or absence of food at 52° and 84% relative humidity and 35°C. Very few weevils died at 84% relative humidity when food was present.

24. Skeleto-muscular mechanism of the external female genitalia of a Braconid wasp.

S. MASHHOOD ALAM, Aligarh.

The female genitalia of *Stenobracon deesae* is a composite structure of quadrate plates, first and second valvifers and their appendages. It conceals vestibulum which is ventrally limited by the sub-genital plate. Paired quadrate plates are in sclerotic connection, posteriorly, by the intervention of dorsum of the proctiger. The sternal origin of quadrates as emphasised by Zander is unacceptable. The quadrate plates are in membranous connection with the oblong plates while definite ball and socket articulations are maintained with the first valvifers.

The paired oblong plates (second valvifers) are mesal to the quadrate plates and ventrally connected with each other by a membrane, which unlike the views of Imms, has been derived from the 9th sternum. These oblong plates maintain ball and socket articulations with the first valvifers. The paired second valvulae combiningly constitute the 'stylet' whose basal portions, arising from the proximal lobes of the second valvifers, are termed as 'rami of the second valculae'. Proximally the stylet dilates to forma 'bulb' while its entire ventral surface is transformed into a longitudinal groove. This groove is traversed by the lancet. The third pair of valvulae are terminal extentions of the second valvifers and envelope the stylet.

The paired triangular plates (first valvifers) are in articulation with the corresponding quadrate and oblong plates. The dorsal tips of the triangular plates given origin to the first pair of valvulae whose basal portions called 'rami of the first valvulae' grip the rami of the second valvulae. The long distal portions of the first valvulae meet by their mesal margins to form the 'lancet' whose dorsal longitudinal groove in combination with the ventral groove of the stylet forms the 'egg-passage'. The rami of the first valvulae are in connection with a small oval plate through a pair of structures called 'basal branches of the first valvulae'. These branches are not described by Snodgrass in *Atanycolus rugosiventris* (Braconidae). All these basal structures of the genitalia combiningly guard the true gonopore.

The musculature contains both extrinsic and intrinsic muscles, more or less of the pattern described by Snodgrass in the honey bee. There are a few new muscles as well and the writer has tried to assign them with specific functions with a view to make definite additions to the knowledge of the myology of hymenopterous female genitalia.

25. Structure of gnathal appendages and their role in the mode of feeding of *Aleurololus barodensis* M.

S. HAMID MAHMOOD, Aligarh.

The present study on the gnathal appendages of *Aleurolobus barodensis* M., has been done in the light of prevailing controversy on the mode of ingestion in Hemipterous insects raised by Qadri. The writer endorses in *A. barodensis*, Qadri's observations on the structure and function of gnathal appendages of *Idiocerus* sp. (1949) and *Pyrilla perpusilla* (1950).

The gnathal appendages of *A. barodensis* consist of paired mandibular and maxillary bristles and the unpaired labium. The mandibles are modified into thin stylets with their bases in the mandibular plates. The greater part of these bristles flank the maxillary bristles in the dorsal groove of the labium. Proximally they possess mandibular levers and protractor and retractor muscles while their distal free tips are blunt.

The maxillae are modified into long thin stylets. Their basal portions are lodged in the maxillary plates with definite maxillary levers and function as regions of insertion for protractor and retractor muscles. The maxillary stylets are distinctly longer than the mandibular stylets with their tips comparatively pointed. The presence of interlocking mechanism on the apposing inner surfaces of the stylets gives rise to a dorsal and a ventral canal, functioning as food and salivary canals respectively.

The labium forms a 3-jointed beak with a longitudinal dorsal groove to lodge the bristles. The apical segment is lanceolate with a definite clasping mechanism. It is provided with well developed extrinsic and intrinsic muscles.

The mandibular bristles do not take the lead in the formation of the wound. It is the maxillary bristles which make the wound. The mandibular stylets simply follow them and anchor into the tissue during ingestion. The labium not only functions as a clasping organ but also helps in lowering the fascicles into the wound by retracting itself into the oral fossa.

26. Studies on the glands of the Head Capsule of Red Pumpkin Beetle (*Aulocophora foveicollis* Lucas) Fam. Chrysomelidae.

K. G. BHANDARI, Delhi.

Within the head capsule of Red Pumpkin beetle, *Aulocophora foveicollis* L., unicellular, multicellular acinose and multicellular tubular glands are present. According to their location the glands are classified into general hypodermal, labral, ocular and antennal, some are intra-mandibular, mandibular, mandibulo-maxillary, maxillary intra-cardinal and labial. They open in the pre-oral cavity as well as outside it. The multicellular simple tubular glands variety (mandibulo-maxillary and maxillary glands) are considered to be salivary in function; whereas the remaining glands seem to be offensive in function, the nature of the secretion being the same as in the case of reflex bleeding. The prothoracic glandular sensillae are numerous pit-like depressions on the pronotum. This is the first record of the presence of such glandular sensillae in Coleoptera.

The paper is illustrated with 12 text figures.

27. A study of factor governing the choice of hosts and distribution of progeny by the Braconid *Microbracon hebetor* Say.

G. C. SENGUPTA, Cuttack.

The present work attempts to determine the factors involved in the selection of hosts by the Braconid *Microbracon hebetor* Say and examines the distribution of the eggs of this parasite in a restricted environment such as obtains when the females are kept in immediate contact with the host larvae.

It is shown that the distribution of the eggs of the parasite is not at random but has reference to the nature of hosts available at the time. The female usually selects unparasitised hosts, and if forced to superparasitise, chooses those hosts containing the youngest parasite stage. It is suggested that the graded oviposition response of the females towards hosts containing advancing developmental stages of the parasite may be conveniently correlated with the decreasing quantity of actual host material present within the host larvae. If only parasitised hosts are accessible, the female tends to retain her eggs rather than deposit them. The exercise of restraint is shown to be related to the developmental stage of the parasite on the parasitised host.

28. Cases of myiasis in man due to *Oestrus ovis* Linnaeus, (sheep bot).

B. C. BASU, P. BALARAMA MENON and C. M. SENGUPTA, Izatnagar.

The paper records four cases of myiasis in man due to *Oestrus ovis* Linn. All the four cases were prisoners in the wool factory of the Central Jail, Bareilly (U. P.). They were struck on the nostrils by flies. The cases showed typical symptoms of nasal myiasis. The adult fly collected while striking on the nostril has been identified as *Oestrus ovis* Linnaeus. All the cases occured between October and December. Myiasis due to *Oestrus ovis* Linn. (sheep bot) is not common in this country.

The object of this note is to draw attention of the possibility of myiasis in man due to *Oestrus ovis* particularly in sheep rearing areas. With the development of sheep industry cases of human myiasis are expected to increase in number and may become a problem of public health.

29. Studies on the bionomics of *Tabanus* flies in the field with a view to work out control measures.

B. C. BASU, P. BALARAMA MENON and C. M. SENGUPTA, Izatnagar.

Studies on the above subject are being conducted in villages around Izatnagar. Muttrapur, Maheshpur, Kareli Kangana, Latori and villages near Nakatia river on Shajahanpur and Pilibhit roads have been selected as sites of observation. The seasonal incidence of these flies and the nature of their breeding site and season have been kept under close study. A number of species of *Tabanus* are prevalent in this area, the more common ones being: *Tabanus rubidus* Wied., *Tabanus striatus* Fabr., *Tabanus macer* Bigot and *Tabanus virgo* Wied. All the species have been found to breed profusely on the following species of aquatic and subaquatic plants: *Paspalum distichum* Linn., *Oryza sativa* Linn., *Poligonum glabrum* Willd., *Scirpus erectus* Poir., *Eichhornia crasspies* Solms., *Poligonum alatum* Ham., *Salix tetrasperma* Roxb., *Arundo donax Linn*, and *Typha angustala* Borry and Chaub.

In the act of oviposition, the tabanids generally have their heads downwards and go on moving down slowly till the laying is finished. Nearly half an hour is required for egg laying, after completion of which, the fly suddenly disappears. The freshly laid eggs are silver white in colour which gradually changes to brown and then black. The bunch of eggs has been found to have different patterns with different species.

Rivers, streams and large ponds are seen to be their ideal breeding sites in this area. The breeding is at a very low level in winter months, rises with the advent of spring and again falls with the advent of summer reappearing with the rains.

In certain areas, particularly in Kareli Kargana village, the egg clusters were found to be parasitized by a Hymenopterous insect. In some of the batches almost all the eggs are found parasitized. The specific determination of the parasite is under study. The work is in progress.

30. Distribution of *Tabanus* flies in India and the adjacent countries.

B. C. BASU, P. BALARAMA MENON and C. M. SENGUPTA, Izatnagar.

In order to have a ready reference of the distribution of *Tabanus* flies in India, their incidence was plotted in a map of India, divided into five regions as recommended by the Indian Council of Agricultural Research in connection with the orientation of different agricultural research organisation in India depending mostly on rainfall, soil, type of crop, etc. The following are the regions with their Tabanid fauna:

1. **Temperate Himalayan Region :** Nineteen species of *Tabanus* are recorded from this region, of which seven are specific to this region.
2. **Eastern Wet Region:** Thirty-two species are recorded from this region, of which nine are specific to this region.
3. **North Western Dry Region:** Seventeen species are recorded from this region of which two are specific to this region.
4. **Southern Region :** Twenty species are recorded from this region, of which three are specific to this region.
5. **South Coastal Wet Region :** This region is represented by ten species of which two are specific to this region.

The incidence of *Tabanus* flies in India has also been arranged according to its natural physical features, dividing it into four regions, namely, Montane, Submontane, Pastural and Coastal. It is noted that as many as thirty species are recorded from the Montane region of which ten are specific. Submontane region has thirty-two species of which three are specific. Pastural region is represented by twenty-three species out of which seven are specific. Lastly, Coastal region is represented by fifteen species of which three are specific. *Tabanus rubidus* Weid. is found to be cosmopolitan in all the regions.

Out of the seventyfive species of *Tabanus* recorded from India and the sorrounding countries, the following seven have been reported to be capable of transmitting surra : *Tabanus ditaeniatus* Mac., *Tabanus macer* Bigot, *Tabanus nemocallosus* Ricard., *Tabanus rubidus* Wied., *Tabanus striatus* Fabr., *Tabanus tropicus* Panzer and *Tabanus virgo* Wied.

31. Observations on *Lema praeusta* Fab (Chrysomellidae) as a pest of turmeric.

G. C. SENGUPTA, Cuttack.

A Chrysomellid beetle—*Lema praeusta* Fab. infests turmeric leaves in Phulbani and G. Udayagiri in the Orissa State. This is the first record of this beetle as an important pest of turmeric in India, though it is known to be a minor pest of many grasses and other plants. A short account on the life history, food habits, distribution, nature and extent of damage to turmeric crops has been given. *Lema praeusta* Fab, completes its life cycle in 40-50 days under laboratory conditions at Cuttack. The maximum number of eggs laid by a female was 58 and the maximum longevity 60 days. The grub and adult of the beetle feed on the tissues of the turmeric leaves. The infestation of leaves ranged from 9.2% to 13.5%.

32. On a sternal gland in Termites.

H. S. VISHNOI, Delhi.

The paper deals with a gland noticed by the author in worker and soldier castes of the termites belonging to the genera *Odontotermes*, *Microccrotermes*, *Eutermes and Coptotermes.* The gland lies ventrally within the visceral cavity below the ventral nerve cord attached to the sternite in the fourth abdominal segment. In reproductive castes any structure similar to this is not present. Possibly the gland has a suppressive influence on the development of the reproductive organs in worker and soldier castes of these termites.

ARACHNIDA

33. An account of the coxal glands in Scorpions.

M. D. PARTHASARATHY, Bangalore.

This paper embodies an investigation into the general morphology and histology of the coxal glands of some scorpions mainly belonging to the genus *Palamnaeus* with special reference to the cytoplasmic inclusions found in the gland cells.

The coxal glands of scropions are situated opposite the bases of V and VI appendages and show a high degree of organisation. The coxal gland consists of a saccule, a labyrinth, a bladder and finally an exit tubule leading to the outlet at the base of the III leg. The detailed histology of the gland is explained. Besides this, the lymphoid nature of an accessory structure characteristic of *Palamnaeus* containing also larger phagocytic cells is described and the absence of this very interesting organ noted in Buthid members. The presence of a definite connection between this organ and the main gland is established, thus showing that this structure might function as an auxiliary in the role of excretion.

Kolatchev preparations reveal the presence of golgi bodies and mitochondria in the labrinth cells, distributed irregularly throughout the cytoplasm. The former are of various shapes and the latter are in the nature of brownish or yellowish brown granules. Their significance is being studied.

MOLLUSCA

34. Is *Melanoides tuberculatus* (Muller) parthenogenetic ?

JOSEPH JACOB, Annamalainagar.

An examination of over two thousand specimes of *Melnoides tuberculatus,* in different stages of growth and from different localities at different times of the year was made, but all the specimens were found to be females. ......o male was ever come across. An examination of the brood-pouch and the histology of the gnoad showed that the sex was female in every one of the numerous specimens and no trace of textis or sperms was seen. Cytological investigation has been undertaken. There is no maturation while the oocyte is attached to the ovarian wall. Oogonial divisional spindles have been observed. Only one non- reductional maturation division of the egg appears to occur in the broodpauch. Further investigation is in progress.

35. The physiology of feeding and digestion in *Melania crenulata.*

V. R. MEENAKSHI, Annmalainagar.

In the stomach there are whirl-pool like movements of the food particles caused by ciliary action. The course of the currents is described and sketched in the paper. (2). The lightest particles in the food enter the digestive gland and are ingested by the cells of the digestive gland. (3). The remaining portion of the food is subjected to the action of the crystalline style and fine material passed into the digestive gland. (4). Rejected particles from the digestive gland and heavier particles in the food are directed into the intestine, (5) The mechanism of these food currents is described. (6). Feeding experiments have been carried out. The animal is not a voracious eater; being microphagous. It scrapes the food slowly. The animals have been successfully fed on filter paper, Indian ink, boiled rice, saccharate of iron etc. (7). The animal does not take Congo fibrin or boiled egg albumen. In other words proteins are not taken by the animal. (8). The digestive gland is an organ of intracellular digestion and the sole organ of absorption of food. (9). The digestive gland extracts have shown the presence of amylase, maltase, glycogenase, inulase, cellulase and lipase. (10). There is no trace of protease anywhere in the alimentary canal. (11). The crystalline style contains an amylase, a maltase, a weak invertase. Repeated experiments have also shown the presence of a very weak lipase, which is interesting in view of the negative results recorded by previous workers on other style-bearing gastropods.

36. Ciliary currents in *Cerithidea cingulatus* Gmelin (Gastropoda-Pectinibranchia).

V. SADASIVAN, Port Blair.

In the first part of the paper the various regions of the alimentary canal are described. The dorsal ciliated groove in the oesophagus carries food particles. The salivary glands are reduced and are only mucus secreting glands. The stomach glands are reduced and are only mucus secreting glands. The stomach shows a prominent typhlosole on the ventral part and other minor grooves and ridges in the posterior part. The pyloric region of the stomach is ciliated and the gastric region cuticularised. The cuticle in the anterior end of the typhlosole is thickened to form the gastric shield. There is a crystalline style lodged in a separate sac and works against the gastric shield of the stomach.

Three main types of ciliary currents found in *Certithidea cingulatus* are described in the second part of the paper. The first is represented in the currents on the mantle edge. The single row of stumpy tentacular projections on the lower side of the mantle edge and the mantle border above the row of tentacles are ciliated. The movements of these cilia create the current. Currents in the mantle cavity, the second type described, are caused by the ctendium which also combines the function of respiratory organ. The currents entering the mantle cavity through the inhalent aperture can take either of two ways; along the respiratory tract on the roof of the mantle cavity and finally beaten to the floor of the mantle cavity, or, along the mantle floor into the food groove and finally through the exhalent aperture to the outside. The smaller food particles entering the mantle cavity with the current are taken to the ctenidial filaments where they are beaten into a mass by the action of the apical cilia of the filaments and transferred to the food groove. The larger particles drop to the floor of the cavity and are carried to the food groove. The rejection currents carry the consolidated food particles to the outside. These currents also serve to keep the mantle cavity free from clogging with unwanted matter. The ciliary currents of the stomach are concerned in sorting out the fine particles which can be digested and in taking them to the digestive diverticula for intra-cellular digestion and rejection of unwanted matter into the intestine. The cilia in the grooves and ridges of the stomach are intended for directing the food particles into the sorting area.

VERTEBRATA

37. The formation of synovial cavity in different joints of the skeletal system of the Vertebrates.

H. K. MOOKERJEE, D. N. GANGULY and Miss GOURI GHOSH, Calcutta.

Little information is available on the formation of the synovial cavity in the Vertebrates. Schulin (1879), Hultkranz (1897), Lewis (1901), MacBride (1920), Faldino (1921), Haines (1947), and Gray and Gardner (1951) have advanced views of the different modes of formation of the synovial cavities.

The present authors being familiar with the formation of different types of joints like pre-and post-zygapophyses, condylo-vertebral joints, girdle joints, carpo-wrist articulations, finger, ankle and toe joints have come to the conclusion that mesenchymatous cells migrate into the blastema from the periphery during early stages of development. A so-called interzone is formed within the cartilage. A slit appears usually from the periphery to the centre in the middle of the interzone and the cartilage is cut into two, a feature noticed for the first time by Mookerjee in his studies on the vertebral column.

FISHES AND FISHERIES

38. Surface transport of the fingerlings of the Mirror Carp, the Leather Carp, and the Scale Carp from the Nilgiris to West Bengal.

D. M. PUNWANI, Barrackpore.

An account of the surface transport of an experimental consignment of the fingerlings of the Mirror Carp, *Cyprinus carpio* var. *specularis*, (Linn.); the Leather

Carp, *Cyprinus carpio* var. *nudus*, (Linn.); and the Scale Carp, *Cyprinus carpio* var, *communis*, (Linn.) from Ootacamund in the Nilgiris to Barrackpore in West Bengal, in January 1950, with a note on the conditioning and care during transport in a round tin carrier of the type commonly used by the Madras Fisheries Department is detailed.

Thirty three specimens of the Mirror Carp ranging from 55 mm. to 100 mm., five of the Leather Carp ranging from 50 mm. to 55 mm., and seventeen of the Scale Carp ranging from 45 mm. to 100 mm. stood the transport across 1465 miles in 72 hours without a single mortality despite a minor accident en-route, thereby establishing the high degree of their hardiness and suitability for cross-country transport for stocking various inland waters.

39. Effect of different concentrations of H_2S (Sulphuretted Hydrogen) on the Oxygen consumption and survival of fingerlings of major Indian Carps.

S. P. BASU, Calcutta.

Experiments on the effect of different concentrations of H_2S upto 5 p.p.m. have been carried out on the fingerlings of major Indian Carps such as *Catla catla*, (Ham.), *Labeo rohita* (Ham.) and *Cirrhina mrigala* (Ham.). The size and weight of the fish varied from 12-16 cm. and 25-50 grms. respectively. Gold fish having the size and weight of 10-12 cm. and 20-25 gms. respectively was also used as a test animal.

The experiments are carried out in a continuous flow system. The technique of dosing H_2S has been described. The behaviour of fish to different concentrations of H_2S is recorded. Observations are recorded every ½ hour on the rate of flow, inlet and outlet oxygen, CO_2, pH, temperature, H_2S concentration during the period of observation in majority of the cases varied from 3-6 hours and in few experiments this is extended for more than 24 hours.

The results show that 2.5 p.p.m. H_2S is lethal to the fingerlings even when other conditions remain optimum, whilst Gold fish can stand 4 p.p.m. H_2S. Increase in H_2S concentration in the medium is followed by the decrease in O_2 consumption by the fish until lethal limit is reached. However, Gold fish is not affected upto 3 p.p.m. H_2S. The results, therefore, suggest that H_2S should be eliminated from the medium because of its high toxicity and also to have normal oxygen consumption of the fish.

40. Certain observations on the bionomics and fishery of the Big-jawed Jumper *Lactarius lactarius* Cuv. and Val.

K. CHIDAMBARAM and G. K. KURIYAN, Madras.

Commercially known 'kutippu' is the Tamil equivalent of the Big-jawed Jumper, *Lactarius lactarius* Cuv. and Val. Being an important commercial fishery the elucidation of the bionomics of this fish is a problem of study in the Biological Stations in Madras. A preliminary report is incorporated in this paper.

The size of the commercial catches varies between 13 and 26 cms. Females predominate in the commercial landings. The fish generally prefers a calmer sea with a lower salinity. The analysis of the stomach contents of 403 specimens examined is presented.

41. Preliminary observation on the distribution of fry collection centres, method of collection and the fry trade in the river Bhagirathi of West Bengal.

H. K. MOOKERJEE, D. N. GANGULY and B. N. MITRA, Calcutta.

In spite of the fact the proper development of our fisheries depends largely on easy availability of the fry at a considerably cheaper rate, scanty information is available as to the distribution of fry of different fish, collection centres and the fry catching industry in the major river systems of the State of West Bengal. The river Bhagirathi and its lower reach, the Hoogly, were surveyed by the authors. Three zonations can be clearly made out: (1) estuarine zone, (2) mixed, and (3) fresh water. Fry collection is poor in the estuarine zone where fishes bred largely. A description of how the fry is collected in both estuarine and mixed zones is given. Fry collection is extensive in the fresh-water zone. The use of *Sutijal* and *Behuti jal* nets is mentioned and the disadvantages under which the fry catchers labour hard are also brought out.

42. The development of the vertebrate column in *Anguilla japonica.*

H. K. MOOKERJEE, D. N. GANGULY and B. MOOKERJEE, Calcutta.

Contrary to the observations of previous workers, the authors have established that in the vertebrate series, the perichordal tube plays the main role in centrum formation and that the arches do not take part in it. This fish was selected to see if the most degenerate type of larvae also conformed to the general plan and also to find out if there were any adaptive modifications due to the wriggling movements of the fish.

The perichordal tube forms the centrum; the latter possesses two pairs of epicentral bones with wing-like extensions. The basi—and inter-dorsals jointly make a complete neural tube. There are 2 neural spines. Dove-tailing of the consecutive vertebrate, below the zygapophyses, is also seen. Variation is observed in the first six vertebrate; an incomplete membrane-bone roofing it is noticed and the zygapophyses and dove-tailing are absent. The haemal arch is formed by basiventrals and interventrals. Ribs are absent.

43. On the life history of *Barbus stigma* (Cuv & Val).

H. K. MOOKERJEE, D. N. GANGULY and S. K. BRAHMA, Calcutta.

A complete account of the bionomics, breeding season, and time of spawning giving all details of the surroundings and of the appearance of structures during the development of Barbus fry is given.

A complete account is presented of the bionomics, breeding season, spawning ground and time and a number of other factors relating to the reproduction and development of this fish.

44. On specimens of *Wallago attu* (Bl. and Schn.) with two pairs of mandibular barbels.

N. N. MAJUMDAR, Delhi.

In a collection of fry and fingerlings of different fishes from the river Jumna near Delhi, four specimens of young *Wallago attu* showed additional mandibular barbels. Of these four specimens two have an additional pair of mandibular barbels over and above the normal pair, while the other two have the normal pair and the right one of the additional pair, the left one being absent.

The number of barbels and their exact position in a fish are points which are of great taxonomic importance.

This finding of additional mandibular barbels in four specimens of *Wallago* lends weight to the remark of Miss Haig that the new genus and species (*Silurodon hexanema* Kner) is only an abnormal specimen of *Wallago attu.*

45. The occurrence of trimethylamine oxide in a few Indian marine fishes.

R. VENKATARAMAN and S. T. CHARI, Kozhikode.

The occurrence of the trimethylamine oxide the precursor of trimethylamine, a useful index in assessing the quality of fish—in the three Indian marine fishes., *viz.* Mackerels, Oil Sardines, and Silver Bellies, has been proved. The method of isolation of this tertiary oxide as a picrate from the muscle has been outlined and their melting points given.

46. Studies on mackerel fat variations : correlation of plankton fat with fat of fish.

R. VENKATARAMAN, and S. T. CHARI, Kozhikode.

Further studies on the mackerel fat variations have been made with special reference to the fat in the plankton, which forms the food of the fish (*Rastrelliger kanagurta* Ruppell). Surface hauls of plankton were estimated for the fat contents and the results have been correlated with the fat in the flesh and also in the whole mackerel fish. Results show that the fish is fatty during October-November and again during March-April, confirming previous results This is attributed to the intensive feeding activity of the fish on fatty plankton.

47. Studies on salting of pomfrets.

R. VENKATARAMAN, and A. G. VASAVAN, Kozhikode.

A series of experiments were carried out to assess standards in salting of big size (12″ average) pomfrets in dry weather with special reference to the ratio of salt to be used. The fish were slit open, entrails removed and incisions on the flesh were made with a sharp knife. After thorough washing in sea-water, salt was applied in the ratio 1: 3, 1: 4, 1: 5 and 1; 6. The salting time was 18 hours and the drying time 20 hours in temperature 30 to 33°C, R.H., 70 to 80%., and air velocity 5 to 15 M. P. H. Observations on the spoilage of the samples were made for four months visually and by the analysis for H_2O, T. V. B and Na C1. Signs of spoilage appeared after three months in samples which had a lower salt ratio and the sample which was salted with 1 lb. of salt to 4 lbs. of fish, remained good for a much longer period under ordinary conditions of storage. This product had a sodium chloride content of 28 to 30 per cent on the dry basis and water content of 35 to 40 per cent. This corresponds to a T. V. B. of 192 mgm. percentage after 120 days, while for other samples values were nearly double. A ratio of 1 lb. of salt to 4 lbs. of fish may be fixed as the correct ratio for big size pomfrets in dry weather.

48. Bacteriology of salted fish and salt. II. The bacterial content of various salts.

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

The 'Red' halophilic bacteria present in three common salts have been enumerated. It was found that Tuticorin salt used in West Coast Yards, and Wadala salt manufactured under the auspices of the Council of Scientific and Industrial Research, Bombay, contained very few (less than 1000) red halophiles, while the salt used in Mettur fish curing yard contained a large number (168,00) of these. The incidence of 'Red' attack on Mettur salted fish is thus a result of a high load of these organisms in the salt used in curing.

49. Bacteriology of salted fish and salt. I. Red halophiles from salted fish and salt.

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

'Red' halophilic bacteria were isolated from salted fish and salt their growth properties and bio-chemical reactions studied. When cultured under a relative humidity of 75% in a desiccator at 37°C, very quick growth was obtained in 7 to 10 days which has not been so far reported. Similarly profuse and good growth in 7 days was obtained on salt potato. At 4°C, no growth was observed upto 4 months. Proteolytic and sachharolytic tendencies of these strains were noted. One strain produced indole also. All the strains isolated were gram positive cocci and no red forms were noticed. Morophologically they were all non-motile cocci in irregular clusters or chains, sometimes single, also.

Solar salt is the source of these red-halophiles. Use of sterilised salt and storage at temperature near 4°C are necessary to prevent the growth of these red organisms on salted fish.

50. On the anatomy and histology of the palate of *Cirrhina mrigala* (Ham.), with special reference to the papillae present on it together with comments on their possible respiratory function.

N. N. MAJUMDAR, Delhi.

This paper gives the anatomy and histology of the palatal lining of *Cirrhina mrigala*. The lining of the anterior half of the palate is modified into a number of comb-plates and folds which bear papillae on them. The posterior half of the palate is provided with many papillae. Similar plates and papillae have also been observed in *Cirrhina reba* (Ham.), *Labeo dero* (Ham.) and *Crossocheilus latius* (Ham).

Histological study shows that the palatal lining is richly supplied with blood and the sub-mucosal core of each papillae is provided with many loops of blood capillaries. All these structures—the plates, folds and papillae increase the area of the palatal lining which presumably help the blood in getting more of dissolved oxygen from the water.

A comparison of survival period outside water, in the three common carps —*Catla catla* and *Labeo rohita* that do not have plates, folds or papillae on their palate, and *Cirrhina mrigala* with such structures, shows that *Cirrhina* can thrive the longest.

These evidences lead one to believe that the papillae on the palate of *Cirrhina mrigala* help the fish in respiration in water deficient in dissolved oxygen.

51. On the occurrence of subcutaneous mandibular barbels in *Silonia silondia.* (Ham.).

N. N. MAJUMDAR, Delhi.

The occurrence of a pair of subcutaneous mandibular barbels in *Silonia silondia* (Ham.) has been described. These two barbels lie embedded in the skin of the lower jaw. A transverse section of these barbels shows that only the cartilaginous rod, which forms the central core of a barbel, is present. This rod is placed between the epidermis and the connective tissue of the skin.

52. Notes on flying fishes of the genus cypselurus.

Miss M. CHANDY, Delhi.

The paper is on the flying fishes studied in the Central Marine Fisheries Research Station, 1948-49, and contains several notes of observation and discussion.

A full description is given of a species of flying fish **(Cypselurus)** that occurs on the Coramandel Coast of India and which forms an important food-fish during June—August, every year. This has been confirmed by the author as a new species. The erroneous identification by Day of the spotted variety of flying fish (*C. spilopterus*) is discussed and its correct name adopted. The paper also contains a report and description of two species of flying fishes, recorded for the first time in Indian waters, and finally a description of a problematic species, which may be new.

The paper is illustrated with two figures.

53. The skull of Gastromyzonid fishes.

L. S. RAMASWAMI, Bangalore.

The Gastromyzonid genera are distributed on the mainland of China and also Borneo. Their distribution is such that forms occurring on the mainland are not found in Borneo and *vice versa.* I have examined *Glaniopsis, Protomyzon* and *Gastromyzon* from Borneo and *Vanmanenia, Crossostoma, Pseudogastromyzon* and *Beaufortia* from the mainland.

The skull study has brought out that *Glaniopsis*, while showing a large number of Nemachiline (Cobitidae) features, also exhibits a few distinctive Gastromyzonid characters. It is very likely that the loachlike *Glaniopsis* may have been the forerunner of the Gastromyzonids on the island of Borneo. It is not possible to derive the mainland forms from any ancestor like the Bornean forms but the characters exhibited by the Chinese forms are such as to warrant the assumption that they have arisen independently on the mainland from a Crossostomid stock. There were three independent lines of evolution, one leading to *Crossostoma*, another to *Vanmanenia* and the third to *Beaufortia* and *Pseudogastromyzon.* Thus there is ample justification for considering the Gastromyzonidae as a polyphyletic assemblage of individuals as has already been done by systematists.

54. On the functional morphology of the alimentary canal of *Wallago attu* (Bl. & Schn.) a siluroid fish, in relation to its feeding habits: Anatomy and Histology.

B. G. KAPOOR, Delhi.

This paper is a part of the comparative study on the functional morphology and histology of the alimentary canal of carnivorous, herbivorous and omnivorous types of Indian fresh-water teleost fishes. *Wallago attu*, a siluroid fish, is selected as a carnivorous type.

An examination of the contents of the alimentary canal shows its carnivorous feeding habits. It preys mostly on the young of carps. Various parts of the alimentary canal have been measured in one fish to give an approximate idea of their relative lengths. The buccal cavity has a well-developed dental apparatus consisting of the mandibular, maxillary, pharyngeal, vomerine and horny-pad teeth. The teeth are homodont, polyphyodont and are directed inwards. The nature of the disposition of mucosal folds has been studied to differentiate the various regions and to correlate these differentiations with the functional morphology.

The study of the histology of the buccal cavity and oesophagus has shown the presence of mucous cells, giant cells and taste-buds. The posterior region of the buccal cavity and oesophagus has a well developed muscularis. It is important to note that the taste-buds are present even in the oesophagus. The muscularis of oesophagus consists of an outer circuluar and an inner longitudinal layer of muscles. This order of muscle layers is reversed in the stomach. The stratified epithelium of oesophagus is replaced by the columnar epithelium in the stomach. The stomach has the characteristic gastric glands of the simple tubular branched type. The glands are present in the tunica mucosae of cardiac and fundus regions of stomach but are absent at the pyloric region. The pyloric region has a well developed sphincter formed by the thickening of circular layer of muscles. The intestine has a typical columnar epithelium with an outer border of top-plates. Wandering cells are present in the epithelium as well as in the sub-mucosae. The short anal canal terminating in the anal papilla has the inner lining of stratified epithelium with mucous and giant cells.

55. Adaptive modifications in a hill-stream catfish, *Glyptothorax telchitta* (Hamilton).

Part II—Teeth, their structure and function.

Miss. BIMLA BHATIA, Delhi.

In a previous communication, published in the *Proc. Nat. Inst. of Sciences of India*—Vol. XVI, No. 4, 1950, the authoress gave a detailed account of the morphology and histology of the adhesive organs of the fish *Glyptothorax telchitta*. This paper is second of the series and deals with the jaws and teeth of the same fish. Both the jaws bear several rows of teeth, which are bony extensions of the jaw and are tunnelled through by a wide pulp cavity, ensuring continuity of growth. Each tooth is curved inwards at the apex and bears an enamel covering in the form of a cap. The jaw bones are slender and mobile. The proximal parts of the teeth are protected by a thick sheath of tissue and only their curved distal parts are visible. The anterior jaw is placed slightly in front of the posterior so that, when the mouth is closed, a part of the anterior jaw with the teeth remains exposed. The authoress explains the great adaptive significance of the morphological details given above.

56. Systematic notes on a collection of fishes from Rajputana.

B. B. L. MATHUR, Delhi.

The Fish Fauna Survey of Rajputana was conducted in 1941 and 1948 by the Zoological Survey of India. Fishes were collected from rivers, streams, waterfalls, tanks and pools of Udaipur, Jodhpur, Sirohi and Palanpur states. The collections were sent to me by the Director, Zoological Survey of India, for identification and record. The collections consist of following species of fishes:—

Family **Cyprinidae**

Sub-family **Abramidinae**

1. *Chela clupeoides* Bloch

Sub-family **Rasborinae**

2. *Barilius tileo* (Ham.)
3. *Barilius bendelisis* (Ham.)
4. *Danio devario* (Ham.)
5. *Esomus danricus* (Ham.)
6. *Rasbora daniconius* (Ham.)

Sub-family **Cyprininae.**

7. *Barbus (Tor) putitora* (Ham.)
8. *Barbus (Puntius) sophore* (Ham.)
9. *Barbus (Puntius) ticto* (Ham.)
10. *Barbus (Puntius) sarana* (Ham.)
11. *Barbus (Puntius) amphibius* (Cuv. & Val,)
12. *Cirrhina reba* (Ham.)
13. *Garra mullya* (Sykes.)
14. *Labeo calbasu* (Ham.)
15. *Labeo nigripinnis* Day.
16. *Labeo boga* (Ham.)
17. *Labeo boggut* (Sykes.)

Family **Cobitidae**

18. *Lepidocephalichthys guntea* (Ham.)
19. *Nemachilus denisonii* Day.
20. *Nemachilus botia* (Ham.)

Family **Gobiidae**

21. *Glossogobius giuris* (Ham.)

Family **Ophicephalidae**

22. *Ophicephalus punctatus* Bloch.

Family **Mastacembelidae**

23. *Mastacembelus armatus* (Lacep.)

The collections comprise 23 already known species. The description of localities with lists of fishes collected from each and also the detailed systematic descriptions of the fishes are given in the paper.

57. A preliminary investigation of the bacterial flora of Mackerels of the West Coast.

R. VENKATARAMAN, and A. SREENIVASAN, Kozhikode.

The bacterial flora of fresh mackerels and putrefying ones have been described. In the slime, 55.6 % of the organisms were *Bacillus* sp., 33.3% were *Achromobacter*, 5.5% were *Micrococci* and 5.5% *Pseudomonas*. In the guts, 3.3% were *Achromobacter*, 33.3% *Bacillus* and 33.3% *Kurthia*. In the gills, 86% were *Baccillus* and 14% *Micrococci*. In the eviscerated (whole) fish, 54% were *Micrococci*, 11.5% *Achromobacter*, 7.7% *Flavobacterium*, 19% *Bacillus*, and 7.7% Miscellaneous.

A high percentage of the organisms liquefied gelatin, produced H_2S and reduced nitrates. There were a large number of chromo-genic strains also. S-R variation has been observed in one strain. The very low percentage of *Pseudomonas* and the high percentage of *Bacillus* may be due to the tropical conditions. Next in importance to *Bacillus* are the *Micrococcus* and *Achromobacter*.

58. Effect of different surface area on the survival and transport of larvae of major Indian Carps.

S. P. BASU, Calcutta.

Successful transport of larvae and fry of major Indian Carps depend on the replenishment of dissolved oxygen and elimination of the accumulated CO_2 in the medium. This is controlled by the water atmosphere interface, the depth of water and the concentration of larvae or fry in the medium.

Experiments are carried out to determine this factor with surface area ranging from 30—3600 sq.cm. per liter of water with a concentration of 400 larvae per liter.

The results show that optimum ratio is within wide limits. A concentration of 400 larvae/liter can survive for 48 hours when the surface area per unit depth is between 16 to 470 under experimental condition increase or decrease beyond these limits is not desirable. The full significance of these results is being analysed in devising a standard fish fry transport can.

AMPHIBIA

59. Thermal exposure to isolated ectoderm cells of amphibian gastrula.

SIVATOSH MOOKERJEE, Calcutta.

The phenomenon of neuralisation by various 'Inductors' has been supposed by Holtfreter as an after-effect of sublethal cytolysis. Experiments have been conducted to test the cytolysing effect of the heat upon the isolated ectoderm cells of *Triton alpestris*. To assay the intermediary role of the nucleic acid in neuralisation, the nature of basophilia of the cytoplasm of thermal exposed cells has been demonstrated by basic dyes.

Ectoderm cells are isolated from the early gastrulae and are exposed to thermal shocks in a special thermostat (devised by Brachet). The range of temperature gradient employed is between 28°C to 42°C. The time of exposure varies from 2 minutes to 24 hours in different cases. The experimental cells are cultured under sterile conditions in isolation for a period of 7 to 14 days. Later they are fixed and sectioned and suitably stained to demonstrate the nature of basophilic granules in their cytoplasm.

Not a single case of neutralisation is observed from a batch of 150 explants. The untreated ectoderm cells have differentiated into epidermis. Presumably, the differentiation of the experimental cells has been blocked; the cytoplasmic basophilia of these cells is removed.

The question of the specificity in cytolysing effect and neuralisation process and the probable role of the nucleic acid metabolism in it have been discussed.

60. Morphogenesis of the thymus gland in Anuran metamorphosis.

M. R. RAO, Bangalore.

A study of the thymus gland during the development and metamorphosis of *Microhyla ornata* throws light on problems of its physiology, the origin of thymocytes and myoid cells, and the process of involution and regeneration.

Volumetric changes of the gland reveal a very close relationship between body growth and hypertrophy of the thymus. Cessation of growth is accompanied by involution of the gland. Thus the gland increases in volume during early metamorphosis. Later in metamorphosis the gland undergoes acute involution. With the emergence of fore-limbs it regenerates, but undergoes degeneration again with the resorption of the tail. In the fully metamorphosed frog the gland again regenerates.

Regarding the origin of the thymocytes there seems plenty of evidence that the thymocytes are formed from cells of the thymic epithelium by gradual reduction in size of their nuclei, and condensation of chromatin, thus supporting the transformation theory of the thymocytes.

During the process of involution the epithelial cells transform into unicellular Hassal's corpuscles which are distributed throughout the gland. These corpuscles undergo progressive degeneration—grouping together of the corpuscles keratinization of their cytoplasm, and karyorrhexis or karyolysis of their muclei. The destruction of thymocytes is carried out by Pycnosis followed by cytolysis and phagocytosis. Abnormal mitosis, chromosomal bridges and macrophages have also been observed.

During the process of regeneration there is hyperplasia of epithelial cells and medium sized thymocytes.

61. Mitochondria in the a-normal hepatic cells of *Ichthyophis glutinosus* (Linn.) and *Uraeotyphlus narayani* (*Seshachar*).

B. A. GULAM AHMED, Bangalore.

Cowdry, Cramer and Luford, Duthie, Browen, Mann, Calkin, Meerssmann and Subramaniam have held that mitochondria have an enzymatic function in the secretary activity of the glandular cells. Horning has given a picture of their enzymatic activity in the Protozoans. In the present paper an attempt is made to study the role of mitochondria in the hepatic cells in fasting specimens of the Apoda. The fasting period is extended from 12 hours to 78 hours. The morphology and physiology of mitochondria in the normal hepatic cells of these forms has formed the subject matter of an earlier paper (Ahmad).

In the early stages of fasting no noticeable change is seen which could be considered as distinct from the normal condition. After the expiry of the 12 hours of fasting the deposition of fat spherules is noticed. They gradually increase in number in the cell and are found scattered profusely throughout the protoplasm around the nucleus. Most of them are small, but a few are larger. The mitochondria also increase in number; all of them are granular; They show a tendency to gather around the fat spherules. In the hepatic cells of forms fasted for 24 hours remarkable changes are seen both in the fat spherules and the mitochondria; the former have increased in size and number, the latter too show an appreciable increase in number, and most of them have arranged themselves around the fat spherules forming a peripheral ring. It is interesting to notice that a clear space is discernible around the fat spherules suggesting perhaps the gradual dissolution of the fat necessitated by the fasting condition. In the hepatic cells of specimens fasted for 48 hours there is an augmentation of the condition seen in the previous stage. The hepatic cells of specimens fasting for 72 hours show the complete disappearance of the fat leaving behind spherical spaces representing the place of the fat spherules in the earlier stages of fasting. The mitochondria have diminished in size, some of them are seen within the circular spaces.

These observations on the Apoda indicate a very intimate association between the mitochondria and the fat spherules. It is evident that they have not only taken an active part in the early stages of the appearance of fat spherules but a very active part in the final dissolution of fat in the advanced stages of fasting. It is probable that fat is used as the easily available food at the fasting time.

MAMMALIA

62. Male reproductive tract of the Indian squirrels.

M. R. N. PRASAD, Bangalore.

The study of the male genital tract of the Sciuridae reveals certain interesting features of taxonomic importance. In this paper the male genital tract of th

Palm squirrel *Funambulus palmarum palmarum*, the Giant squirrel *Ratufa indica maxima* and the Giant Flying squirrel *Petaurista phillipensis* are figured and described.

The genital tracts of *Ratufa indica* and *Petaurista phillipensis* conform in general to the Sciurid type. The tract of *Funambulus palmarum palmarum* does not show the presence of true Cowper's glands, bulbar gland or penile duct. A pair of glands comparable with the para-urethral glands is present enclosed in the musculature of the bulb. While the tract of *F. p. palmarum* differs from the normal, that of *F. pennanti* is of the Scirrid type. The glands and baculum of *F. p. palmarum* are described in detail. They differ from those of the other races of *palmarum* occurring in Ceylon, namely *favonicus* and *brodei*. On the basis of the penial characters Pocock (1923) classified the Sciuridae, but later workers (Osman Hill 1936, '40; Ellerman 1940) have found that a classification of the group on this basis would involve the creation of a large number of species and sub-species and have suggested that no generic names based mainly on the shape of the penis and baculum can be created or retained.

The present work emphasises the fact that the genital tract differs greatly in the forms now supposed to belong to the same genus. A comparative study of the male genital tracts of all the genera of Indian and Ceylonese squirrels has been undertaken to determine the characters of sufficient importance in assessing the inter-relationships of these rodents.

63. Contribution to our knowledge of the structure of the placenta of *Panthera tigris*, the Indian Tiger.

SHYAMA CHARAN SRIVASTAVA, Gwalior.

Most of the study of the placental morphology of the Order Carnivora has remained confined to the domestic animals like Cat and Dog. However, A. Robinson (1940) has given a brief and general account of the placenta in Leopard and stated that it is similar to that in Cat, and Dr. A. Subba Rau, my revered professor, has given a detailed account of the placental morphology of a shed placenta of *Ursus*. Thus the present paper deals with the study of the placental morphology of the most wild animal—*Panthera tigris* which is new. The following observations have been recorded by the author:—

(1) The type of placenta is zonary. (2) The orientation of the placenta is in the proximity of one of the poles of the gestation sac and this fact is new to the study of the Carnivore placenta. (3) The width of the placental belt is unequal as in Seal described by Turner (1875). This fact has not been recorded before in any member of the Family Felidae. (4) The placenta is lamellaeform and the arrangement of villi and lamellae is mostly vertical to the placental surface and parallel to one another. (5) The type of placenta is 'Endotheliochorial'. (6) The 'Giant-Cells' are absent. (7) The zone of Transition extends mostly upto the muscularis and the spongy layer of uterine glands and the paraplacental zone are made out with difficulty. (8) The marginal haematomes are poorly developed and have to ceased to function now.

ECOLOGY

64. Fluctuation of Diatoms and Copepods in the plankton of Krusadai Sea with their inter-relationship and relation to hydrographical conditions.

K. CHIDAMBARAM and G. K. KURIYAN, Madras.

Fluctuation of Diatoms and Copepods in the plankton off Krusadai Island during the years 1944-48 is presented. The Diatom incidence in the plankton in a general way depend on hydrographical conditions like temperature and rainfall. It has also been shown in this paper that while Copepodal population is not in influenced directly by the temperature factor, it depend upon the predominence of Diatoms in the plankton.

65. On the biological productivity of a typical brackish water Tarn (Bheri) of lower Bengal.

H. K. MOOKERJEE, D. N. GANGULY and P. S. MOOKERJEE, Calcutta.

A typical brtckish water tarn in lower Bengal was selected by the authors for the study of its biotic potential. Two types of environments are exhibited by this, *viz.*, the lentic and mixed. Both phyto—and zoo-planktons were studied. Their former continue to grow from the month of January to September. The zoo-plankton grow from July to next January. The adult fish population of the tarn is also described.

66. A preliminary survey of the fresh water plankton from some waters of the Bombay Karnatak.

V. B. MARATHE and P. W. GIDEON, Dharwar.

The plankton samples were collected from tanks, nullahas and rivers during the year 1949-50. The collections were made from 35 localities with a hand-net. The duration of every haul was of 15 minutes.

The major groups of animals were the Cladocera comprising of four families and the *Copepoda* consisting of two. The *Rotifers,* the larval stages of *Crustaceans* and the *Insect larvae* were sparsely represented. The *Ostracods* were rare.

67. The fluctuation of the blue green algae *Trichodesmium erythraeum* Ehrenb. in the plankton off Krusadai Island, Gulf of Mannar.

K. CHIDAMBARAM and G. K. KURIYAN, Madras.

The fluctuation of the blue green algae *Trichodesmium erythraeum* in plankton around Krusadai Island has been described. The main meteriological factors and their bearing on the occurrence of *Trichodesmium* are detailed. The probable effects on the local commercial fisheries have been discussed.

68. Studies on the bionomics of the semi-aquatic grass-hopper *Gesonula punctifrons* Stol.

A. P. KAPUR and D. K. DUTTA, Calcutta.

The grass-hopper *Gesonula punctifrons* Stol. usually feeds on *Eichhornia crassipes*, the common Kachuri-Pana. The paper deals with detailed studies on the following points, *viz.*, (1) mode of oviposition, (2) mode of feeding, (3) development of the ovipositors and wings during the different stages in the life-cycle and (4) a comparison of the development of the different parts of the body during the various instars of development. This grass-hopper has also been found to lay eggs on the petioles of Arum plants, which are often found in abundance in waste places, near around Calcutta.

PROCEEDINGS
OF THE PAST SESSIONS OF
INDIAN SCIENCE CONGRESS

PRICE LIST OF COMPLETE VOLUMES

				Rs.	as.	P.
1st	Session	1914,	Calcutta	0	12	0
2nd	,,	1915,	Madras	1	8	0
3rd	,,	1916,	Lucknow	2	10	0
4th	,,	1917,	Bangalore	2	4	0
5th	,,	1918,	Lahore	5	10	0
6th	,,	1919,	Bombay	3	0	0
7th	,,	1920,	Nagpur	3	12	0
8th	,,	1921,	Calcutta	4	14	0
9th	,,	1922,	Madras	5	4	0
10th	,,	1923,	Lucknow	7	8	0
11th	,,	1924,	Bangalore	6	12	0
12th	,,	1925,	Benares	9	0	0
13th	,,	1926,	Bombay	12	6	0
14th	,,	1927,	Lahore	9	12	0
15th	,,	1928,	Calcutta	12	12	0
16th	,,	1929,	Madras	12	0	0
17th	,,	1930,	Allahabad	15	0	0
18th	,,	1931,	Nagpur	13	14	0
19th	,,	1932,	Bangalore	18	12	0
20th	,,	1933,	Patna	17	4	0
21st	,,	1934,	Bombay	12	12	0
22nd	,,	1935,	Calcutta	15	0	0
23rd	,,	1936,	Indore	18	0	0
24th	,,	1937,	Hyderabad	16	8	0
25th	,,	1938,	Calcutta	30	0	0
26th	,,	1939,	Lahore	20	0	0
27th	,,	1940,	Madras	27	6	0
28th	,,	1941,	Benares	30	4	0
29th	,,	1942,	Baroda	25	8	0
30th	,,	1943,	Calcutta	19	8	0
31st	,,	1944,	Delhi	18	0	0
32nd	,,	1945,	Nagpur	18	4	0
33rd	,,	1946,	Bangalore	21	4	0
34th	,,	1947,	Delhi	23	2	0
35th	,,	1948,	Patna	23	0	0
36th	,,	1949,	Allahabad	21	12	0
37th	,,	1950,	Poona	23	12	0
38th	,,	1951,	Bangalore	27	12	0

The publications or information about them are obtainable from the Indian Science Congress Association, 1, Park Street, Calcutta. Orders should be addressed to the Indian Science Congress Association and not to any Official by name or title.

All Cheques, Money Orders, etc., should be made payable to the Treasurer, Indian Science Congress Association. Orders for books should be accompanied by full name and address, legibly written and should be sent on a separate sheet of paper containing no other communication. In India books are supplied by V. P. P.

SPECIAL PUBLICATIONS

Issued on the occasion of the Silver Jubilee Session of the Science Congress in 1939

THE PROGRESS OF SCIENCE IN INDIA DURING THE PAST TWENTY-FIVE YEARS. *Edited by* B. Prashad, D.Sc., F.R.S.E., F.R.A.S.B., F.N.I., Director, Zoological Survey of India.

A review of the researches carried out in India in different scientific subjects during the period 1910 to 1937. Rs. 5-0-0 per copy.

AN OUTLINE OF THE FIELD SCIENCES OF INDIA. *Edited by* Sundar Lal Hora, Rai Bahadur, D.Sc., F.R.S.E., F.L.S., F.Z,S., F.R.A.S.B., F.N.I., Assistant Superintendent, Zoological survey of India.

An exposition of the manifold field problems involved in the study in India of such subjects as Meteorology, Oceanography, Geology, Botany Zoology, Ethnology, Agriculture, Animal Husbandry Archæology.
Rs. 2-8-0 per copy.

[Reprints of each section are also available]

The publictions or information about them are obtainable from the Office of the Indian Science Congress Association, 1, Park Street, Calcutta-16.

CALCUTTA:—Published by the Indian Science Congress Association, 1, Park Street and Printed by Rajani Bannerjee at Industry Press, 22, R. G. Kar Rd., Calcutta-4.